The Electrical Review

VOL. LXXX. No. 2042. [All Rights Reserved.] JANUARY 12, 1917. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] PRICE (INCLUDING INDEX) FOURPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. SUBSCRIPTION per annum, Postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 8s. 10d. ($5.80); to all other countries, 30s.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque.
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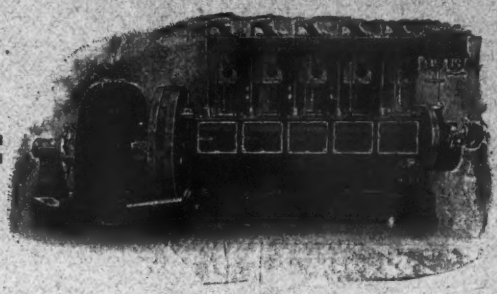

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ELECTRICAL REVIEW.

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Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 1d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

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Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

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PREFERENCE FOR BRITISH MANUFACTURES.

FOR many years past we have advocated the meting out of preferential treatment to British manufactures by our authorities who have the spending of public money. Not only have we urged it in respect of municipal councils, whose contract proceedings the Law requires to be conducted without secrecy, but we have also emphasised the need for greater patriotism on the part of those having the specifying and ordering of plant and equipment for railway works, collieries, docks and harbours, &c., whose proceedings are not so openly conducted, the matter resting between engineers and directors, who have been presumed to act with a single eye to the dividend interests of shareholders. It may have happened that personal predilections have been allowed to come into play, or that there has been an over-zeal for an initial economy in capital outlay at the expense of subsequent efficiency. Cases can be recalled where contracts have been placed abroad by engineers whose sympathies were not suspected of being particularly pro-British; others will be remembered where the fact that a special design or type of plant had not hitherto been made in British works settled the fate of contracts because the specifying engineer or his authority was not inclined to "run risks" or to give British firms an opportunity to launch out in a new direction. There is little room for question now that by such action we were sometimes, as an industry, the long losers, and were deprived of opportunities which might have led to considerable technical developments. There was, however, no restraint imposed, either by law or by general patriotic policy, which required engineers, directors, or municipal councillors to put patriotism before seriously-expected economies or profits, but the imposition of Trade-Union labour conditions here, and their absence in foreign factories, ought to have been more fairly considered in making comparisons. It was not only here, in the British Isles, that these things happened, but in some of our Colonial possessions and dependencies orders were sent from British territory to foreign manufacturers, partly because the engineers responsible either for the installation or for the running of such enterprises were of other nationalities. Perhaps one other factor, concerning which more has been heard in war-time than in the days of Teutonic peaceful penetration, was the readiness with which British purchasers allowed themselves to be fêted as deputations to the land of Electrical Trusts. We are unable to say how far this factor seriously decided the course of business, but we used to hear things said

and we read many an interesting Council Chamber discussion, concerning old-time deputations. We spent too much time visiting countries which manufactured, and too little in visiting the purchasing markets of the world.

The above, however, are things of the past. The future will not, we trust, find history repeating itself in any of these respects. We are in the main all agreed that, whatever may happen to Germany, British support of British electrical and engineering industries will be one of the first essentials henceforth. It is as obvious as anything well can be that there will have to be safeguards of various kinds introduced for the protection of our industries against any of the old kind of Teutonic aggressiveness, and we shall have to be alert for the detection of new devices having the same end in view by more circuitous routes. Some of these safeguards are the subject of deliberations to-day in the meetings of Government Committees, and after all that we have said there is little need to discuss them further at this juncture. There are, however, two matters, on which we have written much at different times, to which we feel drawn to refer again just now. One is that old question of Trade-Union conditions of contract imposed by municipal corporations and some other authorities. In this matter we venture to hope for useful influence to be brought into the scale by Labour which, owing to the war, has gained a new insight into the problems of industry, and especially into the effects of foreign competition. To us, one of the most manifestly unfair features of municipal contracting in days gone by has been the specifying of Trade-Union hours and rates of wages for tenderers, and permitting foreign firms to compete who could not be expected to comply with such conditions. We hardly think that even municipal corporations themselves will consent to the imposition of such inequalities in the future; but if they do Labour will surely lift its voice in regard to a public policy which allows work to go out of Britain to the detriment of British industry and British workpeople.

In view of the heavy financial burdens that we shall have to bear in the future, it will be important to ensure the spending of all public moneys in such a way as shall best conserve the interests of the British Empire, and, so far as these expenditures are concerned, it would almost seem desirable that some authority or other should be set up whose duty it should be to decide whether or not the actual necessities of a particular situation or set of circumstances required the placing of contracts of considerable value abroad in certain specified countries. We should be the last to place anything in the nature of restrictions in the path of free technical development, but we have at times been too free and haphazard in some of our doings, and must look more closely after our own and allied industrial interests henceforth. What, as an industry, we may have to guard against, if we are to carry with us the co-operation of the public authorities, is the temptation to raise our prices to such an extent as to play into enemy hands. This note of warning was sounded, though only, perhaps, parenthetically, at the Mansion House engineering meeting. We are sure that it will be considered judiciously in conjunction with the question of quality.

The efforts which are being made to induce municipal and other public authorities at home and throughout the Empire to register their determination to give a strong preferential treatment to British manufacturers, should be of real benefit to our industries when war pressure is removed. The Trade and Industry Committee of the Royal Colonial Institute has rendered excellent service in this manner of late, and in our "War Items" to-day we record a series of resolutions which have been adopted in Natal. Other organisations are also at work with the object of establishing a very sound sentiment, or, shall we say, of focusing or definitely registering an already existing sentiment, in favour of British products. If we can secure the goodwill and support of Labour at home, and prevent any weakening of policy among purchasers here as municipal councils undergo election changes from time to time, and if we can be assured of the existence of a healthy demand from public authorities throughout other parts of the Empire, we shall have good reason for satisfaction on these grounds alone, apart from whatever other safeguards are secured to us as a result of present deliberations.

Nottingham's Electricity Policy.

RECENTLY, in the course of a lecture on the subject of fuel economy, delivered by Prof. Armstrong at the University College, Nottingham, the lecturer mentioned, in introducing the subject, that he was not till then "aware that Nottingham was the most sinful place in the Kingdom so far as its fuel and power policy were concerned," and went on to comment unfavourably on the city's position as regards electricity supply, pointing out that it was merely "an accident that he lighted on Nottingham as a crying example of the need of reform, and especially of a national policy" (*i.e.*, in regard to fuel and power).

Although it is quite possible that the Professor's remarks were only intended as a general confirmation of the importance of his subject, they incidentally revived a controversy of long standing, locally, as to the judiciousness or otherwise of the policy pursued by the Corporation Electricity Department. Sir John Turney, Chairman of the Electricity Committee, interpreted the lecturer's remarks as an attack on his department, and replied at some length in the Council, while, on the other hand, numerous correspondents resident both locally and in other parts of the Kingdom, have supported and amplified Prof. Armstrong's statement.

So far as we are aware, the outstanding feature of the city's electrical undertaking is the regularity with which it hands a substantial surplus over for the relief of the rates; this in itself is not a criterion of successful electricity supply, but, rather, of astute profiteering (and possibly electioneering). In any case, it is a reversal of what we had supposed to be the municipal ideal, *i.e.*, to supply at the lowest possible price, consistent with financial stability.

Whatever may be the policy of the Committee presided over by Sir John Turney, it has undoubtedly placed Nottingham at a disadvantage in regard to modern means of producing electricity in bulk cheaply—which is the necessity of modern industry—as compared with other cities of similar standing, and if we can trust the statements made in the local Press, the Corporation is even now reaping the fruits of its policy in the number of firms which are apparently installing their own generating plants. Needless to add, the multiplication of minor generating stations is distinctly against the national interests, however it may be regarded by the City Council. It is, of course, not easy at any time, especially for an outsider, to account for the attitude of a municipal committee, and some of them have been known to favour supplying electricity at a loss, ostensibly because of the indirect advantages to the town revenues resulting from the attraction of new, and development of existing, industries; no such accusation can be levelled at the Nottingham Committee, which has evidently gone to the other extreme, much to the disgust and disadvantage, judging by Press comments, of local power-users.

CABLE JUNCTION BOXES.

By S. G.

Much has already been written about electric cables, but very little has been said regarding the various accessories used in connection with them, which are of vital importance to their upkeep.

The heavy first cost of the cables should on no account be overlooked when the question of accessories is under consideration; and in order to maintain the cable network efficiently, it is absolutely essential that the greatest care should be taken in the choice of suitable accessories.

There are several manufacturers of repute who specialise in cable accessories, and engineers should have little or no trouble in getting their demands satisfied. One might say, "But the cost?" In reply, it is only necessary to refer to the ordinary commodities in the household. I am sure the majority would agree that it does not pay to buy cheap stuff.

A word of advice here would be in place: Choose a good firm of high standing, and keep to them; they will get to know your likes and dislikes, just as your tailor does your clothes. Of course, it is up to you to see that you don't get overcharged. The real object of this article is to deal on a small scale with some of the designs already in use, and with which the writer has had experience. It is the small details that make up the complete junction and network box which will be dealt with, and not complete boxes, which the majority of those interested are acquainted with.

Owing to the keen competition which prevails, the users of cable accessories often accept the lowest tender. This may turn out all right in some instances, but there are cases, and not a few, where by paying a little extra a decided saving can be effected; this point is very often discovered by the jointer when it is too late to rectify it.

The choice of accessories requires very careful consideration, and care should be taken to obtain material of good quality, design, and workmanship.

General.—In the first place, junction and network boxes should not be skimped in design. Ample room should be provided for making the joints of the cables, and the box should be of such dimensions that it takes the necessary gear comfortably.

The designer should put himself in the place of the jointer, and consider if he could joint the cables up properly, and, in the case of a network box, he should also place himself in the position of the mains engineer—that is, after the box has been connected up; can the gear, links, or fuses be disconnected easily?

There is one special point which should not be overlooked in the design of a link-disconnecting box, and that is, the connections should be read easily when the links are in position. It should be possible at a glance to tell which

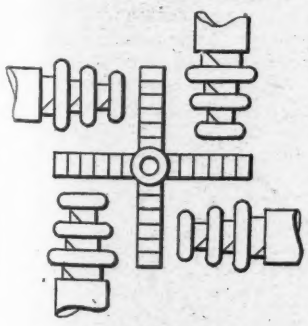


Fig. 1.

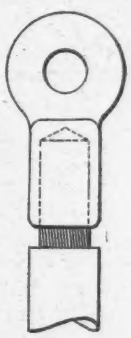


Fig. 2.

is, say, positive, negative, or neutral, or, in the case of three-phase work, the phases A, B, and C should each have a distinctive mark, so that they can be easily recognised.

Fig. 1 illustrates diagrammatically a four-way disconnecting-box for triple-concentric cable; it will be observed that "like poles" can be easily traced.

Sweating Sockets.—The importance of sweating cables into cable sockets properly cannot be over-estimated; the following incident is a case in point. Whilst I was engaged upon a large cable contract, I had occasion to connect up some extra cables into an existing street pillar. It was not until about 3 o'clock in the morning that I could go along with my men to this pillar, as we had been working all night on other points of the system. It was mid-winter, and the most severe experienced for many years. In order to support these additional cables, which, by the way, were very small ones, I "taped" them temporarily to one of the larger existing cables, about ·5 sq. in. area. Imagine my surprise when this large cable came out of its sweating socket. Upon examination, it was found that the end of the cable only entered the socket by about $\frac{1}{8}$ in., although the sweating hole was about $3\frac{1}{2}$ in. to 4 in. long. By the time our small connections were made, it was time for the "workman's car" to commence running, so the best we could do for the time being was to bind the cable to the socket temporarily to prevent it from coming out again.

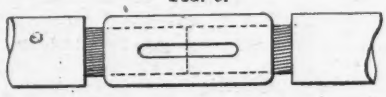
About noon on the same day the police came to my hotel with a report to the effect that there was a strong smell of gas near this pillar. I immediately went to the spot, and discovered a very bad leakage—so bad, in fact, that when I opened the door it flew out of my hand, and I staggered back, the smell being so strong.

After I had regained my composure, I came to the conclusion that a very serious explosion had been averted by the timely discovery of the badly sweated-in cable. There is no telling what might be the outcome of bad work like this; therefore, my advice is "make a good job of it," and see that the fittings are properly tinned before applying the cable.

Design of Fittings.—The design of cable fittings is a matter which requires special attention, and if the following remarks are of no value to the cable engineer who is fairly advanced in his work, they may be of use to the designer or draughtsman.

To commence with, the most simple form of connection is one single cable sweated into a cable socket, or one cable connected to a similar cable by means of a sleeve. Although these appear very simple, there are important points to be observed in the design of the same. For instance, the sweating length for each cable should be at least one and a-half times to twice the diameter of the strand (some engineers insist upon even three or four times the diameter); also in order to make a sound job the cross-section of the sleeve should be so designed that it will carry the full current which the cable is carrying (assumed at 1,000 amperes per sq. in.) at 800 amperes per sq. in. in copper, and

Fig. 3.



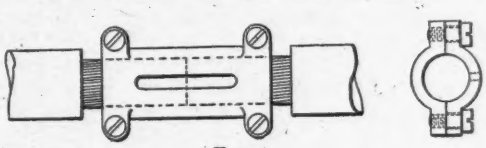


Fig. 4.

means should be provided for pouring in the solder. See figs. 2 and 3. A good supply of grub screws could be provided to make a good job.

A "split" sleeve is sometimes preferred to the above, in which case the same remarks apply. The screws for fixing the two halves together must be mechanically strong. See fig. 4.

Another type of sleeve is the "clamping" type. See fig. 5. This is different to the "split" type, as it is used for clamping the cable without the need of soldering. To make a good job of the joint, the sleeve must be drilled with a packing-piece placed between the two halves, say about $\frac{1}{16}$ in. thick, the size of the drill being just a shade smaller than the diameter of the strand of the cable. The result is that a slightly eccentric hole is formed, and a good grip on the strand is ensured. The same remarks

regarding carrying capacity, &c., apply here also, with the exception that with this type of fitting, when used for mining work, the total length should be equal to at least four times the diameter of the strand.

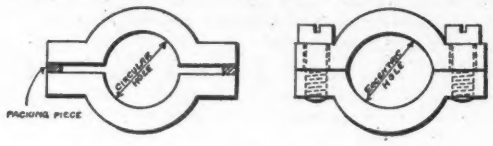


Fig. 5.

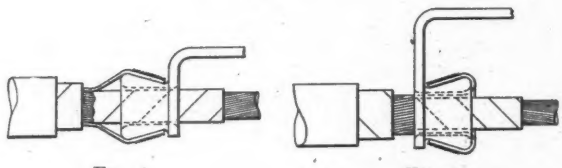


Fig. 6. Fig. 7.

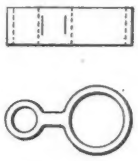


Fig. 8.

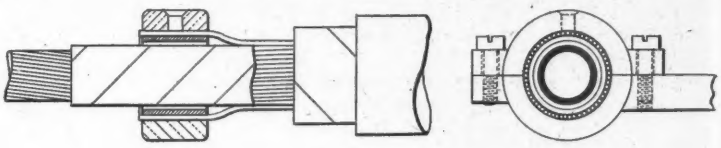


Fig. 9.

The middle and outer conductors of concentric and triple-concentric cables are secured to fittings in various ways. Figs. 6 and 7 illustrate what are termed "binding" fittings. The strands are bent over the conical projection, and secured by means of binding wire, then sweated. One advantage of this type of fitting is its cheapness.

Another type of fitting is illustrated in fig. 8; this is termed a "barrel" or "eye" fitting. The outer conductors are sweated to the inside of the barrel. Although a great number are used, this device cannot be compared to the "clamp" fitting, fig. 9. This is, perhaps, the best of all for concentric cables. As will be seen, a brass sleeve is slipped between the insulation and the outer conductors, then the

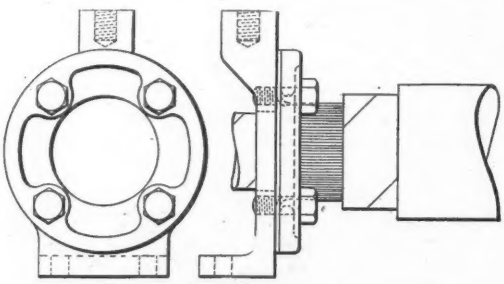


Fig. 10.

strands are clamped round the sleeve and finally sweated. This fitting is specially adapted for use with paper-insulated cables, there being little likelihood of damaging the paper during the process of sweating.

The length of clamp fittings, as shown in fig. 9, for general use, is a point which is sometimes overlooked. The

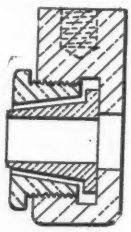


Fig. 11.

following dimensions are suggested for clamp fittings which are also sweated:—Length of fitting = D × ·75, and for fittings which are not sweated D × 1, where D = the bore.

With clamp fittings of the above description, too much reliance is often placed upon the soldering. A clamp fitting is a "clamp" fitting, and it should be bored to such a diameter that when the two parts are screwed together the faces should fit properly, and, at the same time, the conductors should also be gripped securely.

Fig. 10 illustrates what is termed a "ring clamp" fitting, used for concentric and triple-concentric cables. Although this fitting was first introduced about the year 1899, it takes some beating for making a good mechanical as well as electrical connection.

As will be observed, all the strands are clamped on to the main pillar by means of a ring fixed with set screws. The one disadvantage about this fitting when used in boxes is that it takes up a lot of room, and, consequently, the box has to be made much larger than if the fittings shown in fig. 9 were used.

Another type of fitting for concentric cables, and one which makes a really good job, is that shown in fig 11, and known as the "cone" type. The sketch illustrates a fitting to take the end of a concentric cable; but, of course, it can be designed "double ended" to make a straight-through connection, or three-way if desired. This type of fitting can also be used for a single cable by placing some of the strands in the hole and the remainder over the cone.

(To be continued.)

NEW POLYPHASE COMMUTATOR MOTORS.

Alternating-current motors for driving machine tools and for similar service should have practically the same characteristics as the adjustable-speed shunt-wound D.C. motor. The features which make the D.C. motor so desirable for machine tool work are:—

1. The practical constancy of its speed under varying loads.
2. The simplicity and ease with which the speed may be altered to meet requirements.
3. The wide range over which such adjustment is possible.

The first of these is also characteristic of the squirrel-cage induction motor, which in its simplest form is essentially a single-speed machine. It can be designed to run at either of two speeds, one of which is just twice the other, and, by providing an additional winding, at two other speeds bearing the same ratio to each other. A motor of this kind for use on a 50-cycle circuit, for example, might have windings designed for synchronous speeds of 1,500, 1,000, 750 and 500 R.P.M., but no intermediate speeds would be possible without considerable and complicated additions to both motor and control gear. In cases where it is desired to run a machine at two, three, or four definite speeds bearing a simple ratio to each other, and frequent changes from one speed to another are not necessary, this type of motor is quite satisfactory. Like all squirrel-cage motors, it is not adapted for starting under heavy loads. This type of motor has been extensively used for driving small machine tools, and in larger sizes for textile printing machines, &c. The larger sizes are, however, open to objection on account of the occurrence of relatively heavy current rushes when a change is made from one speed to the next.

The normal slip-ring type of induction motor is also essentially a single-speed machine, although the speed can be varied over a wide range with the greatest ease by introducing and regulating suitable resistances in the rotor circuit. When operated near synchronism, its characteristics are similar to those of a shunt-wound D.C. motor. At lower speeds they partake more and more of those of heavily-compounded and series motors, and the plain slip-ring motor is, therefore, unsatisfactory in cases where it is desirable to have practical constancy of speed under varying load, such as is obtained with the adjustable-speed shunt-wound D.C. motor.

Like the squirrel-cage motor, the slip-ring motor can be designed to run steadily at either of two speeds, one of which is twice the other, but this generally involves the use of three additional slip-rings and a more complicated controller. Such a motor has good starting properties, and can often be used where only two steady speeds are required. As in the case of the squirrel-cage motor, additional windings may be fitted to give a further choice of steady running speeds, but the complication and cost of the motor and its control gear then become excessive.

The use of a changeable pole squirrel-cage motor in cascade with a slip-ring motor affords a means of obtaining three definite running speeds, the ratios of which will depend on the numbers of poles in the machines. For instance, a 12-pole slip-ring motor in combination with a squirrel-cage motor designed for four and eight poles will have synchronous speeds of 500, 375, and 300 R.P.M. when operated on a 50-cycle circuit. Combinations of this kind are generally too expensive and complicated for use in small sizes, but the main and auxiliary motor may be combined in one machine with considerable advantage. This has been done under Hunt's patents, and Cascade motors of this kind are on the market. They are subject to the limitation that one number of pairs of poles must be twice the other, so that the maximum and minimum

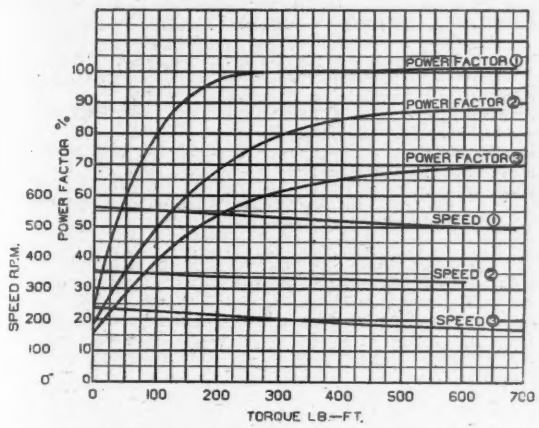


FIG. 1.—B.T.H. POLYPHASE COMMUTATING MOTOR: POWER FACTOR AND SPEED CURVES, FULL-LOAD TORQUE 485 LB. FT.

speeds are in the ratio of three to two. These machines are generally arranged for operation at the minimum speed; intermediate speeds can only be obtained by the use of regulating resistances, as in the case of the ordinary slip-ring motor, and therefore at the expense of constancy of speed under varying load and with greatly reduced efficiency.

Each of the motors and combinations described above has its own special field of application, but none has the same operating features as the adjustable-speed D.C. motor, and in view of the very

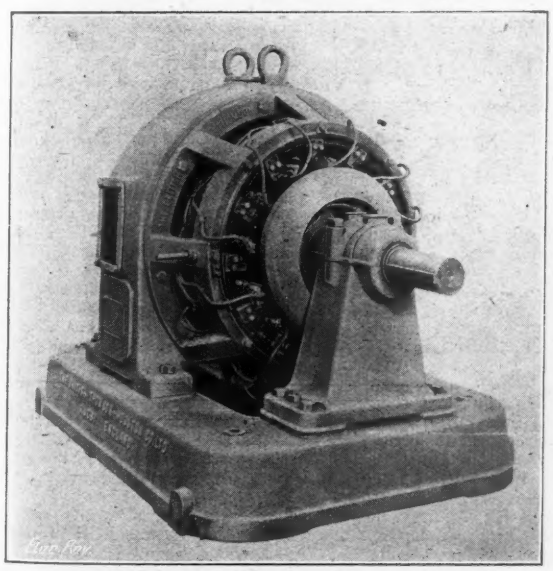


FIG. 3.—50-H.P. B.T.H. MOTOR, 540-180 R.P.M.

general distribution of electric power by alternating-current systems there is a wide field for an A.C. motor with the same characteristics.

To meet this requirement, the British Thomson-Houston Co., Ltd., has introduced an improved type of commutator motor which can be built for pressures up to 600 volts and frequencies up to 60 cycles. Speed adjustment is effected by moving the brushes by means of a large hand wheel, and may therefore be carried on continuously from the lowest to the highest speed, as would be the case with a shunt-wound D.C. motor if it could be provided with a field rheostat having an infinite number of steps.

When the brushes are adjusted for the minimum running speed, the motor may be started by switching it straight on to the supply system; under these conditions the starting current is about one and a half times the normal full-load current, and the starting torque approximately twice the normal full-load torque. The starting properties of this motor are, therefore, superior to those of a standard slip-ring machine, and there is the advantage that a starting rheostat is quite unnecessary. There are no separate resistances or transformers, and the motor is quite self-contained, the only accessory required being the ordinary switch with overload and low-voltage release, or other standard protective devices.

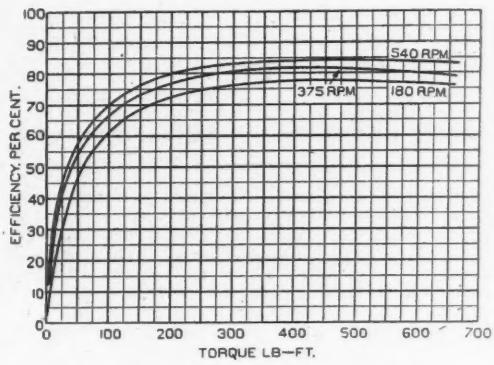


FIG. 2.—B.T.H. MOTOR EFFICIENCY CURVES.

The efficiency at the maximum speed is slightly lower than that of a standard induction motor, but at the minimum speed it is much higher than that of an induction motor of the same speed and power.

The power factor is uniformly higher than that of an induction motor, and at the maximum speed the machine will even draw a slight leading current over a wide range of load.

The output is proportional to the speed, and in this respect alone the new motor differs from the adjustable-speed D.C. machine, which is only capable of giving the same output over its whole speed range.

The curves in figs. 1 and 2 show the results obtained by brake tests of a 400-volt, three-phase motor designed for an output of 50 H.P. at 540 R.P.M., and for speed adjustment down to 180 R.P.M. They are self-explanatory and quite typical. It is interesting to note that with its armature locked and an input of 110 amperes per phase, this machine exerted a torque of 1,020 lb. ft., or more than twice the normal full-load torque with one and

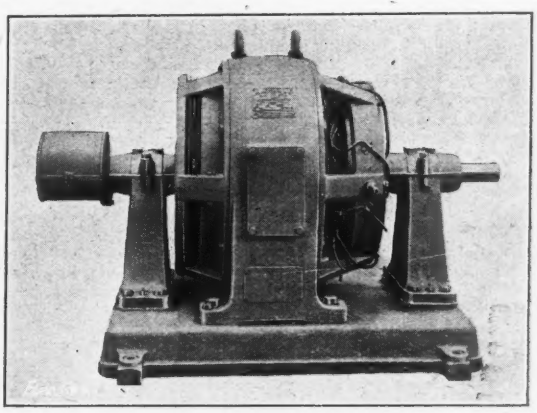


FIG. 4.—30-H.P. B.T.H. MOTOR, 720-240 R.P.M.

three-quarter times full-load current. The motor from which these results were obtained is shown in fig. 3, from which it will be noted that the brush spacing is much more open than is usually the case in polyphase commutating motors. The standard number of brush studs for motors of smaller output than 50 B.H.P. is nine, and for larger motors twelve, and these numbers are quite independent of both frequency and speed range.

Standard machines are designed for speed adjustment between maximum and minimum speeds having a ratio of three to one, but this range may be increased to four to one at slight extra cost, pro-

vided there is no objection to the standard temperature rise being exceeded at the lower speeds. Motors for use on 25-cycle circuits may even be regulated from the maximum speed right down to standstill.

Fig. 4 shows a motor designed for an output of 30 H.P. at 720 R.P.M., with speed adjustment down to 240 R.P.M., and indicates the method of securing satisfactory ventilation at the lower speed. Air is drawn over the commutator surface and through the machine in an axial direction, and then delivered radially through the openings in the end-shield by a fan of large diameter.

These motors may be reversed in the same way as an induction motor; that is, by interchanging two of the primary leads. Like the induction motor and the D.C. shunt-wound motor, this motor acts as a generator, and returns energy to the line when driven above the no-load speed for which it happens to be adjusted.

Dynamic braking can thus be carried out at any speed within the range of adjustment for which a motor is designed, a property which makes this type particularly suitable for the driving of hoists and small winding gears.

AMERICAN ELECTRIC COOKING CONDITIONS.

IN a recent article in the *Electrical Review and Western Electrician*, Mr. H. O. SWOBODA gave an analysis of electric cooking rates and conditions in the States and Canada. He pointed out that the use of nickel-chromium alloy had solved the difficulty of a suitable material for electric heating purposes. Another difficulty was the high cost of electrical energy; the cost was not in many cases sufficiently low to warrant a rapid introduction of the art, although the price was steadily falling, and in many cases special low rates for off-peak loads for installations with electric ranges were being offered.

The author predicts that in a comparatively short time electrical energy will be offered not only in the States, but all over the civilised world at such rates that electric cooking can be universally adopted, and mentions that in England, in quite a number of cities, a rate equivalent to 2 cents per KW.-hour is charged, which is far lower than those in the States, which range from 3 to 6 cents per KW.-hour.

The author goes on to study the data as to rates for domestic cooking in 80 cities, these being situated in 28 different States in the U.S. and Canada; most of these rates are not more than three years old.

Twenty-six systems, or 30.6 per cent., apply a so-called room schedule, in accordance with which the price per KW.-hour is reduced after a certain initial quantity at a high price has been consumed. This quantity varies in accordance with the number of active rooms in the residence. In some instances the number of the square feet of the floor space is substituted for the number of rooms.

Twenty-four systems, or 28.3 per cent., use a two, or multi-rate, schedule. As in the preceding rates, the price per KW.-hour is reduced after a certain initial quantity at a high price, approximately light rate, has been consumed. In this case, however, this initial quantity is the same for all consumers. Some systems make only one reduction in price per KW.-hour; others make two or more, setting for each step a fixed amount of current consumption.

Eighteen systems, or 21.2 per cent., have a plain KW.-hour schedule, there being one uniform price per KW.-hour, regardless of the quantity of current consumed and the capacity (connected load) of the installation.

Twelve systems, or 14.1 per cent., charge on the basis of maximum demand, as is customary for practically all power service.

Three systems, or 3.5 per cent., apply a plain KW.-hour schedule, the same as the other 18 systems just mentioned, but in addition thereto make a fixed service charge per month.

Two systems, or 2.3 per cent., also apply a plain KW.-hour schedule, the same as the other 18 and three systems, but give a discount, which increases with the current consumption.

These figures clearly show that the room and two or multi-rate schedules are the most favoured methods of charging. In these cases the primary rate gives a high return for a small initial amount of energy, usually equal to the monthly demand for light during peak load hours, so that the remainder, representing energy consumed during off-peak load hours, can be sold at a low rate, and one meter only is used for light and power.

Sixty-one per cent. of the systems referred to allow a fixed prompt payment discount; the remainder allow none, and three of them provide a penalty if the bill is not paid in a certain time. Sixty per cent. use one common meter for all requirements.

In order to make a direct cost comparison, the unit price of 100, 200, and 500 KW.-hours purchased in one month was worked out. The lowest charge for 100 KW.-hours is between 1.5 and 2 cents per KW.-hour; the lowest charge for 200 and 500 KW.-hours is between 1 and 1.5 cents; the charge made by more than 50 per cent. of all systems lies between 3 and 6 cents per KW.-hour, and the highest charge for 100 KW.-hours is slightly in excess of 10 cents. The highest charge for 200 KW.-hours lies between 9 and 10 cents, and the highest charge for 500 KW.-hours lies between 7 and 8 cents per KW.-hour.

Of all the systems investigated, 10.6 per cent. charge less than 3 cents for a monthly purchase of 100 KW.-hours, 65.9 per cent. less than 6 cents, and only 4.7 per cent. adhere to the customary charge of 10 cents of 10 years ago.

One of the other factors affecting the electric-cooking rate is the influence of this load on the feeder system, through which the energy is delivered to the consumer. While the maximum demand for a single range seems to be between 35 and 40 per cent. of its connected load, the maximum demand for groups of ranges, as shown in the first three items of Table I, does not exceed 15 per cent. (14.6 per cent.)

TABLE I.—Central Station Rates.—Connected Load, Maximum Demand, and Diversity-Factor for Domestic Ranges.

Name of city or country.	No. of households.	Connected load, KW.	Maximum demand, KW.	Diversity factor.
Salt Lake City, Utah ...	24	77	11·5	15·0 %
Great Falls, Mont. ...	21	110	13·5	12·3 %
Worcester, Mass. ...	16	77	13·5	17·5 %
Anaconda, Mont. ...	22	92	—	—
Canada	1	—	2·9*	—
England	1	6·2	2·2†	36·6 %

* Maximum demand during six successive days.
† 1·75 KW. are light and heat.

of the connected load. In other words, the diversity factor is about 1 to 7, permitting the installation of seven times as many ranges on a feeder system as the connected load apparently would permit. In fact, it is even considered safe (L. A. Gale) to figure on a ratio of 1 to 10, as the maximum demand of the domestic-cooking load does not occur at the time of the station peak.

Similar conditions exist for large kitchens. The two named first in Table II, and supplying regular restaurant service,

TABLE II.—Central Station Rates.—Connected Load, Maximum Demand, and Diversity-Factor for Large Kitchens.

Place of installation.	Connected load, KW.	Average demand, KW.	Maximum demand, KW.	Diversity factor.
Engineers' Club, Boston	30·0	—	18·0	60·0 %
Quaker Cafeteria, Sacramento, Cal.	96·2	—	55·0	57·3 %
U.S. battleship *Texas*:				
Officers' galley ...	120	27·4	54·0	45·0 %
Crew's galley	240	21·2	90·0	37·5 %
Siemens-Schuckert Co., Berlin, Germany ...	93	20—40	40·0	43·0 %
North German Lloyd, Bremen, Germany ...	194	40—60	60·0	30·9 %

furnish meals at all hours of the day to single persons or small parties at short notice, and, therefore, must have a high maximum demand as well as a high diversity factor (57.8 per cent., or 1 to 1.75). The other four kitchens, however, supply meals only at fixed hours of the day to large groups of persons at one time, and consequently have a maximum demand and diversity factor (37.7 per cent., or a 1 to 2.6) fully one-third smaller than the other two. In addition, therefore, it should be borne in mind that battleships, as well as the two enterprises named, have their own power houses, which when the help ceases to work for the purpose of eating, operate with a minimum load, and, therefore, can supply the entire cooking energy without an increase in the capacity of the plants.

In the second portion of the article, Mr. Swoboda turns to the more difficult part of his subject—that of establishing cost data of actual cooking operations.

The difficulties met with are worth recording, in view of the frequency with which such data is tendered in papers and discussions.

He points out that some reports state the energy for heating food only, securing hot water and steam from another source; others include all this, and in one instance the heating of the water for washing dishes is recorded. The type of equipment is often not stated, although efficiencies vary considerably Sometimes energy registered by the meter is used for other purposes and not indicated; also savings in food and labour, and maintenance of equipment are rarely mentioned.

It is assumed that each country has developed a standard practice of its own. In the States and Canada hot water is supplied to the kitchen from the general system of the building; steam also is often available in factories for certain cooking purposes, and the electric equipment consists of a baking and roasting range, though with a single-meter system probably other domestic uses are also included.

The author, evidently judging by the English trial data which he publishes, concludes that it is customary to heat the water by special coke boilers—which is, of course, very far from being true as regards the average English consumer, who will probably continue for some years to use the existing coal range for heating bath water when required, and use the electric boiling ring, just as he now uses the gas boiling ring, for minor requirements.

Mr. Swoboda falls into the further error (if our interpreta-

tion of his remarks is correct) of assuming that it is the usual English practice to give special cooking rates and install special meters for cooking, thus eliminating the use of energy for other purposes.

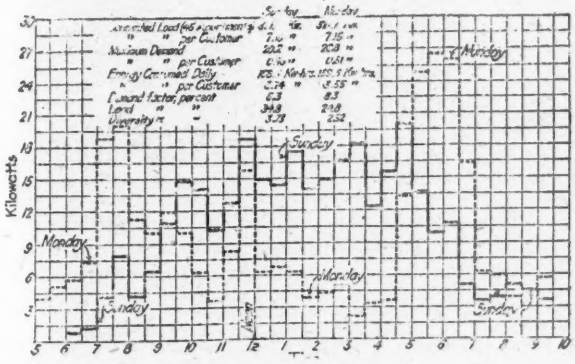
While this is certainly true as regards the two or three individual returns recorded by him of English tests, yet the fact remains that the majority of the progressive electric cooking centres in this country have adopted a domestic or "single meter for all domestic purposes" tariff, the movement having received its impetus from the favourable results obtained by the so-called "Norwich tariff," which was put into use nearly 10 years ago, long before the Americans had made any move in this direction.

Germany, according to Mr. Swoboda, has adopted the system of individually heated cooking vessels to a considerable extent, and heats the water electrically.

Judging by the conditions, it it assumed that the German reports cover only two hot meals per day, as against three in England and America.

The data covers a period of eight years, and the author deduces that in the United States and Canada 1 KW.-hour per day, or .33 KW.-hour per meal, are required; in England 1.36 KW.-hour per day, or .44 KW.-hour per meal, and in Germany .76 KW.-hour per day, or .38 KW.-hour per meal.

The German figures include water heating, and correcting for this the cooking figure becomes .20 KW.-hour per person per meal, which low average is attributed to the use of individually-heated utensils in place of large ranges.



COOKING LOAD CURVE OF AMERICAN APARTMENT HOUSE.

Average electrical consumption means little to the purchaser of an electrical stove, who would naturally like to know the approximate monthly bill. Tabular data from American sources shows that the average bill is $3.5 per month for a 3-cent rate. In addition, it is mentioned that at Billings, Mont., with 300 ranges, the lowest bill is about $1.50, and the usual highest about $5, neglecting a few careless consumers who incurred bills up to $10. For fully one-half of the consumers the bills were not more than $3.6 per month each.

The company operating at Twin Falls, Idaho, guarantees that the bill shall not exceed $4.8 per month for any household.

The energy consumption in the case of restaurant kitchens (a la carte service) ranges from .95 to 1.21 KW.-hours per meal, and for large kitchens, feeding groups of persons at fixed hours (as the U.S. Battleship *Texas* and a large German cable works) from .33 to .43 KW.-hour per meal. The energy consumption falls off with experience of the use of the apparatus.

The author draws attention to the ease with which electric heating can be applied to individual apparatus, such as table utensils; to the possibility of using automatic temperature regulation in ovens, and introducing exact cooking methods leading to certain results, in connection with which time and temperature data has been published by Lancaster and Gumaer.

The saving in both labour and food are referred to, as well as the superior quality of the food when cooked.

Several of the tables reproduce English results which have already appeared in our pages.

We notice that the author avoids all reference to the first cost of apparatus, which is a greater obstacle in this country than the cost of energy to the general adoption of electric cooking, and judging by opinions of American central-station men set forth in the report of the Electric Range Committee of the N.E.L.A. (quoted in our issue of October 6th) is also not without influence on progress in the States.

Mr. Swoboda's paper, which contains 21 tables of electric cooking data, is an instructive summary of the present position of the art. We can only regret that more representative English data was not available, or, at any rate, not included, although from the "business getting" point of view, probably more convincing than any data to the average person is the knowledge that other people, in similar circumstances, are adopting the electrical method. This fact is, for instance, corroborated in an article by Mr. S. M. Kennedy which appeared recently in the *Electrical World*. He mentions the case of a lady who was about to construct an apartment house, and wanted independent advice regarding the advantages of electric cooking in such a case. The local power company referred her to 13 apartment houses in different parts of the States, and 10 of these replied, all stating that the electric range filled all the cooking requirements of the tenants; the rate paid averaged 3 cents per KW.-hour, and monthly bills varied from 1.75 to 3.50 dollars, averaging 2.15 dollars. All advised the equipment of the new apartment house with electric ranges as being clean, safe, economical, and modern. The unanimity of the replies was a revelation to the lady who applied, and to some of the power company's employés. [We reproduce a typical load curve from a house of this type containing 45 apartments.] Mr. Kennedy also referred to a half square mile area in a rural district in Southern California, where of the 16 houses in the block, 14 are using electric ranges, despite the fact of there being natural gas mains only 1,000 ft. distant. One householder was induced to purchase a range, and it is significant that within less than four months, the other 13 residents followed suit; this is not an isolated experience on this company's system.

THE PARALLEL OPERATION OF ELECTRIC POWER STATIONS.

ON December 12th the paper on this subject by Mr. J. S. PECK was discussed by the SCOTTISH LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS. An abstract of the paper appeared in our issue of December 1st, 1916.

Mr. W. W. LACKIE (Glasgow), who opened the discussion, admitted that Glasgow was one of those cities guilty of having separate stations for traction and power, but these had for years been run in parallel when required. In Glasgow they had had considerable experience in linking-up. In 1898 the Corporation purchased the Kelvinside undertaking, and in 1912 the Partick and Govan stations were taken over by the Corporation and linked-up with the Glasgow system, and it was not very long before the consumers' lamps and wiring were brought into line with the Glasgow pressure, and the Partick and Govan stations were then run in parallel with the Glasgow stations when required. In the case of the Kelvinside station, it supplied its own area from 3 to 11 p.m., when the load was considerable, but during the remaining 16 hours of the day the load was drawn from the main power stations. Govan and Partick stations would have undergone similar treatment had not the war compelled the suspension of operations. For stations of less than 3,000 KW. which were to be linked up with large power stations, it would be found practicable to change consumers' lamps and apparatus to a pressure and periodicity to suit the larger power station. There were 14 local authorities and 14 supply companies in the London area supplying electricity. There was no doubt that the 12 of these of under 3,000 KW. maximum demand could and should be tackled, which would practically halve the number of generating stations in London. It appeared to him that for many years linking-up would be limited to an exchange of energy at times of light load, *i.e.*, at week-ends and on holidays, and in some cases for all-night loads. Consequently, when apparatus had to be installed it would not be necessary to have it of anything like the capacity of either of the stations connected. When Port Dundas, St. Andrew's Cross, and Pinkston stations were linked-up, fortunately they had the same voltage and periodicity, and little trouble was experienced. The plant at Pinkston at that time consisted of reciprocating engines, running at 75 R.P.M., coupled to alternators with 40 poles, whereas the plant at Port Dundas consisted of turbines running at 750 and 1,500 R.P.M., with 2 and 4-pole alternators. One or two adjustments had to be made before all went smoothly, but there was nothing of a serious nature. The three stations were now run in parallel at times of full load, and interconnected with cables which, between Pinkston and Port Dundas, were over one mile long, and between Pinkston and St. Andrew's Cross between two and a half and three miles long. All the stations might be said to be of different capacities, and yet there was no difficulty in arranging the load amongst them. He could not say what the speed regulation of the reciprocating engines at Pinkston was, but he thought it was very different from the speed regulation obtained from turbine-driven sets. If a rotary was to be used for interconnection both ways it must have independent field excitation if it was to be anything like stable. This arrangement was adopted in the Falkirk electricity department.

Mr. WHYSALL (Greenock) pointed out that it was a fact that many stations were being satisfactorily operated when linked-up to each other without any of the devices spoken of by Mr. Peck. His personal experience of linking-up was small. In Greenock they had interconnected with a small hydro-electric system at very short notice, and there had been no difficulty. In connection with the linking-up of two undertakings having a different periodicity, he favoured the synchronous motor-generator, and thought they should be prepared to accept its disadvantages.

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Mr. ARCH. PAGE (Glasgow) argued that the necessity for considering complicated phase-converters and frequency-changers was a reflection on the short-sighted policy which was followed in the early days of electricity supply. One undertaking in Scotland started out by offering its prospective consumers 3-phase, 2-phase, or direct-current supplies all at different voltages. In Glasgow they were running four stations linked up, with an aggregate capacity of 60,000 KW. The first two stations had been running together since 1905, and the electricity department and tramway systems were linked up in 1908. So long as the stations were working in tandem, or, as one might express it, in series, there was no trouble. The only limiting factor was the capacity of the interconnecting cables. They had recently closed the links forming a triangle, and the possible necessity for some type of trunk cable was looming up. He was afraid the impression conveyed by this paper to engineers who had no experience of running A.C. stations in synchronism, and who were contemplating this step, would be unfavourable, and it might even have a deterrent effect. It could not be too strongly pointed out that so long as the frequency was common, whether or not the voltage varied, the running of any number of stations linked-up was a very simple matter. In Glasgow, apart from the economies effected (and these had been considerable), the great feature of linking-up had been the factor of safety so far as continuity of supply was concerned. This might be noticeable there because the tramways department had little or no lighting load, and the margin of spare plant in Pinkston was always available to help the electricity department when sudden darkness came over the city. They had all kinds of plant, reciprocating engines and turbines, with varying regulation at the steam end, also throttle and cut-off governing. The better regulating machines did take up the fluctuations, but with the large number of plant units in commission the ammeters were fairly steady. The load distribution was easily controlled by the switches for regulating the speed, which were mounted on the main control panels. It might be well to sound a note of warning to engineers who were thinking of linking-up, to make certain that the capacity of the interconnecting cables was not only adequate to deal with the load to be transferred from one station to the others, but that there should be a margin of copper to deal with the fluctuations, which in the case of, say, a tramway or railway load would be shared by the prime movers in the second station which ordinarily was dealing with a power and lighting load. He asked the probable efficiency of the phase-converters; anyone who had had experience of the tricks of motor-generators and rotaries when there was a surge on the A.C. system knew how unreliable these frequency-changers were bound to be. As to the question of regulators in the feeders, he asked Mr. Peck where his preference lay as between the induction type and step-by-step regulation. It was their practice to have a voltage-regulator on only one station.

Mr. SEDDON thought that linking-up would no doubt hasten the growth of larger stations, with a corresponding reduction of plant in the smaller ones, and this change would operate to the advantage of the supply authorities. Probably only in the case of stations of about equal plant capacity would exchange of load take place. At times, transfer of load would have to be effected with low frequency and volts down on the disabled station, so that auxiliary bus-bars would be required. He believed synchronous motor generating plant was the best coupling to adopt. Where it was required to connect a single-phase station with a 3-phase supply of a similar frequency, he believed Scott-connected 3-phase to 2-phase transformers was the best method.

In his reply, Mr. PECK pointed out that those with 3,000-KW. stations and under could change to the standard frequency of the district; pressure could be cheaply changed by transformers being rewound. As regarded frequency, if the station was small and uneconomical, it was time it was scrapped. It might involve the changing of voltages, and there might be a difficulty in changing from 25 to 50 periods, or from 40 to 50, and it would be necessary to make some radical changes in the motors or couplings. It was standard practice to put in a rotary-converter for correcting speed deviations, and speed would fluctuate unless there was some exciter to make the speed stable. Small independent stations would probably be changed into sub-stations for distributing purposes, which would be to the general advantage. Let them have large stations by all means, though he did not see why the small stations should not do what they could. The small station could be run with a governor, and at waste-heat stations let them supply all the energy they could. He thought it was quite possible to transfer at unity power factor between stations without boosters if a small difference in voltage was allowed. Step-by-step regulators were considerably more efficient than induction regulators, which also took a considerable amount of current from the line, although, perhaps, not so much as to affect a large system. On the other hand, the induction regulator would give a uniform variation in voltage and also had the advantage of being motor or automatically driven. As to his illustrations, they must remember that the speed of motors was constantly being adjusted to make the stations take up the desired load, the governors being set for a certain regulation, and having the load factor over the whole range. In practical working, extreme ranges seldom or never occurred. His impression was that a frequency-converter would be somewhat cheaper than a phase-converter of the motor-generator type with a 3-phase motor and 2-phase generator, or *vice versa*. To link up a system with 30,000 KW. of plant, a frequency-changer of 38,000 KW. would be required, and a number of frequency changers were in use approximating that capacity. If they were not to scrap odd frequencies, and wished to link up large systems, it would involve large cost for frequency-changing apparatus.

WAR ITEMS.

Trading With the Enemy.—The "London Gazette" for January 5th contains further lists of persons and bodies in the following countries with whom trading is prohibited:—Argentina, Uruguay, Bolivia, Brazil, Chile, Colombia, Greece, Morocco, Netherlands, Paraguay, Spain, &c.

The Controller of the Foreign Trade Department has issued a new consolidating list containing the names of over 2,000 persons and firms with whom persons in the United Kingdom are forbidden to trade. Cases still come to the notice of the Department in which firms are corresponding with persons on the statutory list, and they not infrequently give as an excuse that they have never heard of the list. Everyone engaged in foreign trade should realise that he is under an obligation to make himself familiar with the statutory list, and to observe it. Failure to do so renders him liable to the heavy penalties provided by the Trading with the Enemy Acts, and these apply to holding any communication whatever with anybody on the statutory list, and not merely to entering into an agreement or continuing to carry on business with such persons. In exceptional cases a licence may be obtained from the Foreign Trade Department exempting from the prohibition. The statutory list is published at intervals in a consolidated form, and additions are made approximately at intervals of a fortnight. Copies of the consolidated list and of all additional lists may be obtained at a small cost from the Superintendent of Publications, His Majesty's Stationery Office.

The German Aron Meter Co.—It is stated that all the shares in the H. Aron Elektrizitats Zahler Fabrik, G.m.b.H., of Charlottenburg, have recently passed into the possession of German subjects. As a consequence, the compulsory administration introduced by the Ministry for Commerce has been abolished.

Tramways Substitution.—The Municipal Tramways Association announces that arrangements have been made with the War Office for the establishment of a substitution scheme applicable to tramway undertakings for dealing with employés of military age.—*Daily Telegraph.*

Women Workers.—The "Times" states that a woman has been placed in charge of the electric lighting station at Bradninch, near Exeter; also that women are to be employed for "gate" work on the London tube trains. They will not be so employed on the "District" at present.

Sleeping at their Posts.—At the Hull Munitions Court, three local electrical workers were charged with being asleep when they should have been at work. They were engaged on a 24-hour shift on a ship. It was stated that owing to the fact that their particular department did not work diligently the ship was delayed for three days. The Electrical Union desired a heavy penalty to be imposed for this slacking. Two of the men were fined £2, and the third, aged 17, who said that this was the first time he had done a 24-hours' shift, was fined £1.

Natal and Preference to British and Allied Manufacturers.—*The Board of Trade Journal* recently stated that the Durban Town Council had decided to submit the following resolutions to the Natal Municipal Association for consideration and adoption:—

"1. (*a*) That every Natal Municipal Council and Local Board be asked to affirm the principle that all goods and materials purchased out of the public funds should be the produce of British or Allied countries, and that such a condition shall be inserted in all specifications for the supply of goods or materials, unless it can be shown that such goods can only be purchased from neutral countries.

"(*b*) That every Natal local authority be asked to furnish to the Secretary of the Natal Municipal Association, for transmission to the Right Hon. the Prime Minister, a return of those goods which it has been customary to purchase from enemy or neutral countries, with a view to the information being forwarded to the Union High Commissioner in London, for publication for the information of British manufacturers.

"2. That the Natal Municipal Association be recommended to submit resolutions (*a*) and (*b*) to the next meeting of the United Municipal Associations of South Africa, and that that Association be urged to impress upon its constituent authorities in the Cape, Transvaal, and Orange Free State Provinces, the desirability of acting in the direction indicated in those resolutions."

Exports to China.—The "London Gazette" for January 9th contains a further list of persons and bodies in China and Siam to whom exports may be consigned.

Vacancies in the O.T.C.—Men suitable to train as officers, whose exemptions are about to expire, and young men about to reach military age, are advised that there are now

vacancies in the Inns of Court Officers' Training Corps. They should call without delay for a personal interview with the Selection Board at 10, Stone Buildings, Lincoln's Inn, London, W.C., any day (except Saturdays) between the hours of 10 a.m. and 4 p.m. No appointment is necessary.

Optical and Glassware Munitions.—The Minister of Munitions has made an order requiring all persons engaged in the manufacture, purchase, sale, or other dealings in chemical and medical glass or glass tubing and rod to comply with regulations restricting the manufacture unless the glass is required for an Admiralty, War Office, or Ministry of Munitions contract, or the supply is authorised by the Director of Optical and Glassware Munitions, 117, Piccadilly, London, W. The purchase and sale outside the United Kingdom of chemical or medical glass or glass tubing or rod is also restricted. Chemical and medical glass includes carboys, thermometers, glass for miners' safety flame lamps, glass for X-ray apparatus, &c. Certificates will be granted to dealers to order reasonable quantities of chemical and medical glass and glass tubing and rod for the purposes of stock and/or export, provided that such orders are not considered by the Minister of Munitions as likely to interfere with the execution of orders required for war purposes. No further authorisation to dispose of such stocks will be required, provided that in the case of articles, the export of which is prohibited, the usual permit to export be obtained.

Exemption Applications.—At the West Riding Appeals Tribunal, at Leeds, last week, the City Tramways Committee appealed for four single men, armature winders and electrical equipment repairers. The matter had been previously adjourned for the department to try to find substitutes, but it was stated that suitable men had not been obtainable, and, much as these men would like to be released for military duties, it was found impossible to grant their request. There were at present 70 or 80 cars unfit for use owing to lack of skilled labour. With a little more time the department might be able to get the substitutes. The cases were further adjourned, the Corporation representative undertaking to report when the men were replaced.

The City of London Tribunal has given a final extension of two months to a plate-glass merchant, single, aged 30, who has been learning wireless telegraphy, and wants to sit for the Postmaster-General's examination in February.

At Bacup, the secretary and manager of the Corporation electricity department asked for the exemption of an engineer (30), whose certificate had been withdrawn from the recruiting office. The man appealed for had the oversight of 1,000 H.P. of current for power purposes, four miles of high-tension mains, a similar extent of low-tension mains, in addition to the overhead street lighting of the main roads. The Military Representative said he was bound to put on pressure, as the man was single, young, and passed for general service. The manager replied that the difficulty was to replace him. He was the only one with a knowledge of the undertaking. Exemption was granted to March 31st, but the Tribunal thought some steps should be taken to replace him.

At Southport, appeals were heard for three men in the Corporation electricity department: a storekeeper (38), passed for C2, a plumber and cable jointer, general service, and a meter tester and attendant (37), B2. The electrical engineer said that so far as the department was concerned they considered they had got to the limit. The cable jointer was given conditional exemption, and temporary exemption to March 1st was granted in the other two cases.

The Birkdale District Supply Co. appealed, at Southport, for a single man (24), general service, employer as assistant engineer and switchboard operator. The manager said they had tried to find substitutes, but with indifferent success. The case was adjourned to February 1st, and it was intimated that the company would have to try and find a substitute.

Before the Stratford-on-Avon Tribunal, on January 3rd, the Military Representative asked for the withdrawal of exemption allowed to Mr. J. G. Bomford (24), electrical engineer, partner in the firm of Messrs. Booth & Bomford, on the ground that it was no longer necessary in the national interest that he should continue in civil employment. Mr. Bomford said that he had been passed in Class C1, and he was engaged on important railway and marine engineering work. The pre-war staff of 20 had been reduced to eight. The application was not acceded to, and the exemption was confirmed.

The Margate Tribunal has given the junior partner in a local electrical engineering firm 14 days in which to obtain work of national interest in his own line of business.

At Broadstairs, on January 2nd, certificates previously granted to four members of the staff of the Isle of Thanet Traction & Lighting Co., Ltd., and to a tram driver, were renewed. The manager (Mr. Forde) said that they had to furnish the War Office with a list of the men who had joined up, and those in a low category would be exchanged for present employés passed as fit for general service.

At Nuneaton, the Military Representative applied for a review of conditional exemption granted to a stoker (35) at the Corporation electricity works. The clerk said that the man was in a certified occupation. The Chairman: A stoker in any occupation, who is married and over the age of 25, is in a certified occupation. The conditional exemption was confirmed.

At Hitchin, on January 1st, exemptions granted by the Recruiting Officer some time ago to essential men in public utility service were, under a new War Office Order, brought before the Tribunal. These included P. Wilson (19) and A. Dobbs (19), on the staff of the electric light station, and they were ordered to be medically examined and classified before the review is made.

At Letchworth, Colonel Sowerby appealed for exemption for A. Edwards (34), electrician at Lilley Manor, and four months' conditional exemption was conceded.

At a meeting of the Newcastle-under-Lyme T.C., on January 3rd, the Electricity Committee reported having considered the staff at the electricity works, and the question of the introduction of female labour, as recommended by the Military Representative. It was decided that, in the opinion of the Council, it was impossible to release any of the present members of the staff for military service; that as the work undertaken by the remaining eligible members of the staff is of a highly skilled nature it would not be practicable to employ female labour; and that the Chairman be instructed to lodge appeals on behalf of the staff when occasion required. None of the eligible members of the staff left are passed for general service.

Before the East Suffolk Appeal Court, the Electric Light Co., at Felixstowe, appealed against local decisions in respect of a Diesel oil engine driver (24), refused exemption, and a wireman, electrician, and gas engine attendant (37), granted until January 31st. It was stated that the staff was barely sufficient for the important work to be done; it was absolutely impossible to replace the men. The refusal of exemption to the younger man was confirmed, and the elder man was given conditional exemption with a view to the military seeking a revision of a conditional exemption certificate held by a single young man at the works.

At Trowbridge, the Military sought a revision of conditional exemption granted to Gilbert Rawlings, electric light attendant at the works of Messrs. J. Sainsbury & Co. The certificate was granted on the ground that Rawlings was in a certified occupation, and the Recruiting Officer contended that, in spite of that, it was no longer in the national interest that the man should be exempted. The Tribunal refused to interfere in the case.

At Newton Abbot (Devon), it was reported that Mr. D. R. A. Millman, electrician, passed in Class C1, had failed to secure work of national importance in the month allowed. Another month (final) in which to comply with the order was granted.

At Maidenhead, on January 2nd, the Tribunal confirmed the certificate of conditional exemption held by Mr. C. O. Milton, borough electrical engineer, who is to remain in the V.T.C.

BUSINESS NOTES.

Scheme of Arrangement.—TYLER APPARATUS CO., LTD.—With reference to the affairs of this company, the list of creditors in which we published in our issue of December 22nd, 1916, we have received a copy of the scheme of arrangement which we understand has been passed by the creditors. Under this scheme the claims of the first debenture-holders, secured creditors, and unsecured creditors will be satisfied as follows:—

The second debenture-holder, Mr. A. M. Powell, will pay off, and take a transfer from the first debenture-holders of the whole of the first debenture for the sum of £1,450. He will also advance to the company a further sum of £1,000 for additional working capital to be secured by the issue of a further debenture for the said amount. As the only debenture-holder, Mr. Powell agrees to the present book debts as at October 13th, 1916 (amounting to £4,500 or thereabouts), being released from his debentures and assigned to three trustees in trust to pay the same over to the creditors from time to time upon the terms and conditions mentioned in a certain deed as from October 13th, 1916. At the expiration of nine months from November 1st, 1916, the company is to pay to the trustees £50 per week out of the income of the company for the benefit of the creditors until such time as the whole of the creditors have received 20s. in the £. In order to allow the company a reasonable opportunity of paying its debts in full and re-establishing itself, Mr. Powell agrees not to call in the principle sums due under the debenture for a period of not less than 18 months from the date of the trust deed, but without prejudice to any of his other rights thereunder in the event of a breach of conditions or reservations.

The receiver at present appointed on behalf of the first debenture-holders is to be discharged, and the balance of any amounts collected by him, or the book debts as at October 13th, 1916, since his appointment, will form part of the trust fund. The Board is to be reconstituted, and three new directors, who have been responsible for bringing and carrying through the above scheme, are to be appointed. All debts not exceeding £5 (the aggregate does not exceed £150) are to be paid out of the funds of the company as soon as possible.

New British Dry-Cell Industry.—After experimental work extending over two years, BRITISH UTILITIES, LTD., has established a factory for the manufacture of dry cells at South Park Road, Wimbledon. We understand that the works have been in operation for some six months, turning out a high-grade cell under the trade mark of "Firefly," and that these cells are guaranteed to stand up for three months in stock. The firm is equipped for large-scale production, and is specialising in medical cells, dry cells for bells, telephones, and ignition purposes, and in refills for popular sizes of electric torches. Needless to add, there is an immense opening for reliable makes of dry cells in this country, and it is a matter of satisfaction that steps are being taken by British makers to meet this demand, despite the difficulties created by the war and the uncertainty of the position

after the war. We can only hope that satisfactory assurances will be forthcoming in respect of the latter question, so that such new industries can be established with confidence.

Catalogues Wanted in Italy.—Messrs. Ing. Stauble and Rag. Salvini, of 76 Foro Bonaparte 76, Milan, who have an established organisation for the sale, &c., of all kinds of electrical material, and have carried out business for many Italian industrial, electrical and telephone concerns, are anxious to establish connections with British manufacturers, and accordingly will be pleased to receive catalogues, prices, conditions, &c.

Catalogues and Lists.—LANGDON-DAVIES MOTOR CO., 110, Cannon Street, London, E.C.—20-page illustrated price list of single-phase and polyphase motors.

MESSRS. FERRANTI, LTD., Central House, Kingsway, W.C.—New pamphlet Ma56, giving very fully illustrated instructions for the use of alternating-current house service watt-hour meters (types FC and FCT).

Cable-Makers' Association.—The address of this Association is now Sardinia House, Sardinia Street, Kingsway, London, W.C.

Liquidations.—KILOWATT PUBLISHING CO., LTD.—This company is winding up voluntarily with Messrs. A. Webster, 203/206, Temple Chambers, E.C., and E. A. Burnie, 59/60, Gracechurch Street, E.C., as liquidators. A meeting of creditors is called for January 16th.

LEITNER ELECTRICAL CO., LTD., Maybury, Woking.—First dividend 3s. 4d. in the £, payable January 24th by Corfield and Cripwell, 119, Finsbury Pavement, E.C.

Calendars and Diaries.—MESSRS. ALFRED HERBERT, LTD., of Coventry, have sent us, as in previous years, one of their serviceable wall calendars, each monthly page of which has very bold block date figuring and interesting pictures of some of the firm's machine tools.

MESSRS. ALFRED GRAHAM & CO., of St. Andrew's Works, Crofton Park, London, have issued, as before, their handy-sized blue pocket book of Tide and Speed Tables for the year. It contains diary spaces and a great deal of information of a general character. Messrs. Graham have also again sent us one of their serviceable desk blotting-pads with diary at left-hand side.

THE DAVENPORT ENGINEERING CO., LTD., of Bradford, have issued a wall calendar with daily slips for 1917. Their patent water coolers are illustrated.

MESSRS. THERMIT, LTD., of 675, Commercial Road, Limehouse, London, E., have prepared the usual calendar and note-book for the current year. As before, the opening pages are devoted to illustrated descriptive matter concerning the company's process.

MESSRS. PECKHAM, DUCAMP & CO., of 90, Charing Cross Road, London, W.C., have prepared a very serviceable and well-bound desk reminder, in which ample spaces are reserved for every day of the year. A small calendar for the current month appears at the top of each weekly page.

Book Notices.—"The Electrical Engineer's Diary," for 1917, has come to hand from Messrs. S. Davis & Co. (price 5s.). As last year, it is published in two editions—one with stiff covers, the other with limp covers. Besides the diary portion, which is printed on sectional paper with a week to an opening, and is provided with four sheets of blotting paper, which can be torn out, and take the place of the interleaved paper formerly used, the volume contains an encyclopædic mass of information suitable for the use of engineers, architects, contractors, &c., and covering almost every subject connected with the generation and use of electrical energy. Official rules and regulations, including the I.E.E. wiring rules, are included *in extenso;* a list of London streets in which electricity mains are laid, and a list of electricity supply authorities in the United Kingdom, form useful features, and the technical information is well up to date, such matters as phase advancers, lighting in war time, &c., being covered. Certainly as a desk companion the engineer will find it an extremely useful work, especially if he makes himself well acquainted with its contents. One often finds that the information, in search of which one has turned the office upside down, was lying close at hand all the time—in the "Engineer's Diary," as likely as not.

The "International Mercantile Diary," issued by Messrs. Syren and Shipping, Ltd., price 5s. net, is intended to facilitate the development of trade between Great Britain and foreign countries, and therefore is provided with very comprehensive foreign exchange tables, arranged on a new method, for the conversion of any sum of money at any rate from or into sterling. Tables for converting British or metric weights and measures into foreign equivalents are also given, which, it is claimed, cover *every* country, and have a far greater range than any previously published. The tables are based entirely upon the decimal system, and the publishers point out that they will, therefore, be of equal value whether the existing British currency is retained after the war or is replaced by decimal coinage with the pound as the unit of value. The book also contains a mass of useful information on matters relating to trade and commerce.

With regard to the tables, we note the usual lack of appreciation of the meaning of "significant figures," some of the equivalents being given to as many as six figures and others to only three; also, in English, centimetre, &c carry no accent. As a rule, it is sufficient to give the equivalent values to four significant figures. There is no "grain troy," the "grain," unlike the pound and ounce, being fortunate enough to have only one value. The boiling point of water is given as 202° F., and the conversion factor from Centigrade to Réaumur is incorrectly stated. The kilometre on page 21 is given as 2,000 metres. Conversion tables are given on an ingenious system, which economises space and facilitates reference; but here again the mistake has been made of giving too many figures, as many as *nine* significant figures being given in some cases. The prefix "myria" is not used in practice. A table appears on page 30, representing the geometrical progression 1, 2, 4, 8, &c., to the 56th term, which is given to 17 significant figures! It would be interesting to know of what practical use such a table can be. Time and space prevent us from commenting further on this remarkable collection of conversion tables, except to say that, in some respects, the author has shown more zeal than judgment. The diary portion is admirably arranged.

"Scientific Papers of the Bureau of Standards." No. 295, "Determination of the Degree of Uniformity of Bars for Magnetic Standards." Washington: Government Printing Office.

"A Laboratory Course of Practical Electricity." By M. J. Archbold. London: Macmillan & Co., Ltd. Price 5s. net.

"Science Abstracts." Sections A and B. Vol. XIX, Part 12, December 27th, 1916. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each.

Industries of the Empire.—The following is a copy of a statement issued last week by the Trade and Industry Committee of the Royal Colonial Institute:—

"For some time past the Trade and Industry Committee of the Royal Colonial Institute has been engaged upon the work of encouraging the establishment of new industries in the British Empire, with a view to giving a measure of confidence and security to capital to be embarked therein, as well as assisting the expansion of existing industries. As a result of a resolution, the Committee has been in communication with the Governments and Chambers of Commerce of the Dominions and Colonies with a view to urging the necessity of making it obligatory on all Government and municipal bodies to purchase Empire-made goods, and to place all contracts as far as possible with British firms. Such action, in the opinion of the Committee, would prove a strong factor in stimulating the establishment of new, and the growth of existing, industries, as well as consolidating inter-Empire trade.

"In response to the communication sent by the Trade and Industry Committee on the subject, replies have been received from 28 Governments and 21 Chambers of Commerce and Boards of Trade, which go to prove that the Empire is united in the desire to assist and encourage Empire trade, and to take such action as may be deemed appropriate and feasible. There is naturally diver gence of views as to the methods to be adopted for attaining the object in view, mainly on account of the various systems of government which exist in the British Empire, but it is satisfactory to find that the Crown Colonies and Colonies not possessing responsible government are unanimous in their desire to co-operate in carrying out the principle embodied in the communication of the Committee. As regards the self-governing Dominions, there is a general desire to comply with the terms of the resolution, and to take such steps as will ensure unity of action in the future.

"The Chamber of Commerce of Sydney affirms the principle that all Government Departments, Municipalities, and other public bodies spending public money, should purchase Empire-made goods and place all contracts with British firms where possible. The Chamber of Commerce of Melbourne states that the principle embodied in the resolution is already largely in force in the Commonwealth, and that the Chambers of Commerce throughout Australia have already taken steps to carry out the principle embodied therein. As regards South Africa, the resolution was adopted at a meeting of the Association of Chambers of Commerce of South Africa in Cape Town on September 12th last. The Chambers of Commerce in India have taken active steps in connection with trade after the war, and have formulated a series of suggestions for the Empire as a whole. They strongly advocate the extension of the system, by which Government Departments and local authorities give preference to British goods, and that local authorities should only use other than British goods if actually forced to do so by considerable advantage in favour of such foreign goods. The replies are, on the whole, of a very satisfactory character, and may be seen in the Trade and Industry Department of the Royal Colonial Institute, Northumberland Avenue, W.C."

Trade Announcements.—The offices of the PHILLIPS COMMUTATOR GRINDER CO., LTD., have been removed from the City to 122, Walworth Road, London, S.E.

THE LONDON ELECTRIC FIRM has removed to Brighton Road, Croydon. Telephone No. "68 Purley."

For Sale.—The Wolverhampton B.C. Electricity Department has for disposal two mild-steel steam separators. For particulars see our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Australia.—Electric power from the Public Works Department power house at Port Kembla will be used in the construction of the great dam on the Cordeaux for the Sydney water supply; a survey for a cable is being made over the distance of about seven miles, which is on the way towards the southern line towns to which the Works Department has offered a supply of power. Mittagong, one of these towns, has decided upon a

municipal installation, and is about to ask the ratepayers' consent to the raising a loan. North Illawrra Council, which has for some considerable time been contemplating an installation, has recently received offers for the supply of power from the South Bulli and the Corrimal Collieries, but has been unable to come to any decision up to the present.—*Australian Mining Standard.*

Bedford.—Extension Scheme.—As mentioned in a previous issue, a special meeting of the T.C. was called to consider the extension scheme at the electricity works, which had been recommended by the Electricity Committee, at an estimated cost of £33,980, of which sum a prospective consumer outside the borough was to advance £5,080. A great diversity of opinion was shown in the discussion, Mr. W. E. Sowter voicing the case of the Committee at considerable length, and (judging by the Press report) giving excellent reasons why the new work should proceed. However, on a vote it was decided to rescind the resolution of the Committee to carry out the extensions, by 12 votes to 11. A motion was then carried appointing a sub-committee to seek better terms from the contracting parties, and during these proceedings Mr. Sowter handed in his resignation, as he took the vote to indicate a lack of confidence in the Committee. The discussion revealed the usual lack of understanding of matters electrical; and although an array of aldermen foregathered to squash the proposed extension, none of them apparently offered a suggestion for meeting the immediate new demands of 720 kw., for which, according to Mr. Sowter, no generating plant is available.

Belfast.—Extension Scheme.—The monthly meeting of the Corporation was marked by a rather acrimonious discussion in connection with the proposed new power station. Sir John Snell wrote that he had had a conference with the chairman of the Electrical Committee, Councillor Duff, and the Electrical Engineer, and as a result he asked for further information, after which he would be able to present a report. Sir John further suggested another conference in London, which was approved. Councillor Alexander again drew attention to the unsatisfactory state of the electrical supply, and said that surely a local man could be got to keep the station in order. Our correspondent says the margin of power over the demand is very small at the present time, and it is quite evident that something must be done at an early date to supplement the supply.

Bradford.—War Wages.—Having before it a considerable number of applications from workers, and recommendations from Corporation committees, the special Corporation Committee to deal with war wages and bonuses agreed last week upon an equitable flat-rate addition to pre-war rates of pay as the best way of dealing with the whole matter, and adopted for recommendation to the City Council the following scheme:—Advances and bonuses given since the commencement of the war, either in accordance with Trade Union rates or otherwise, shall, in the case of men, be made up to a total of 8s. per week on the rates or scales in operation on August 4th, 1914. In the case of women and youths, the bonus will be increased from the present 2s. to 4s. per week. In the few cases in which increases during the war have exceeded 8s. per week, there will be no reduction, and if during the continuance of the scheme the standard rate of wages in regard to any trade should be increased to cause the aggregate increases to exceed 8s., the new standard will be paid. The revised bonus allowance will be added to the normal remuneration of the married employés serving with the Forces in arriving at the allowances payable to their wives. The new bonuses are to be regarded as war wages, and recognised as due to the existence of the present abnormal conditions, and will be applied proportionately to the actual wages earned, whether more or less than the wages of a normal full week. This scheme, if approved by the City Council, will apply to all Corporation employés except a dozen or less.

Burnley.—The Electricity Committee will be prepared, on the conclusion of hostilities, to consider the question of supplying electricity to the Rose Grove district.

Chippenham.—Workhouse Lighting.—The B. of G. has appointed a Committee to consider the question of having the electric light installed at the workhouse. The Electricity Co. has offered to install a plant with 136 lights and 126 switches, at a cost of £175, and to allow £50 for the present gas fittings. If the Guardians take the light for five years the payments could be spread over that period, and the maximum cost of lighting would be £55 per annum. The House Committee had recommended the acceptance of the offer as being a reasonable one.

Continental.—Portugal.—The *Times* correspondent at Lisbon says that by a decree just published there, the consumption of gas and electricity is reduced in the case of public lighting by 50 per cent. and of private by 30 per cent.; the closing hours of shops is fixed at 7, and that of theatres and cafés at 11.

Darlington.—The Corporation electricity undertaking has a capital of £128,936, and a revenue of £27,177 resulted from last year's working, equal to 9·42 per cent. on the capital employed. The last year is the only one in the last eight that the department has not transferred any of its surplus profit in aid of the rates. The depreciation fund amounts to £7,318, while £5,515 has been spent out of profits on capital works.

Dewsbury.—War Wages.—The Electricity Committee has resolved to grant the application of the Amalgamated Society of Engineers for an advance of 3s. per week in the wages of men employed in the electricity works from October 1st last, subject to it being recognised that the advance is a war wage and dependent on the existence of the abnormal conditions. It was resolved to grant an additional 2s. per week war bonus to all the staff at the electricity works, except one man already dealt with.

Doncaster.—Street Lighting.—At a recent meeting the Mayor said, with regard to the recently adopted limited system of lighting the town by electricity, that the electric lamps had served their purpose so well that he would like to see them replace the gas lighting all over the town.

Dublin.—Loan Sanction.—The re-borrowing by the Corporation of £46,816 in respect of the electric lighting undertaking and refuse disposal works has been sanctioned, and steps have been taken for the creation of stock for that amount.

The Special Investigation.—In a letter to the Dublin Corporation as to his position in connection with the City Electricity Undertaking and the reports of Mr. D'Alton and the Special Committee of Inquiry, Mr. L. J. Kettle, Deputy City Electrical Engineer, declares his readiness to put his opinion on the matter to a test by running the works or the undertaking against Mr. D'Alton for a week, a month, or a year under similar conditions, and guaranteeing to show at least equally good results. "I will wager my salary," he says, "for the time being against his on the result, and if I am proved incompetent, you will not be under the necessity of getting rid of me, for I shall not wait for that. If I win, I am confident you will show appreciation." Mr. Kettle mentions that he has time and again asked to be paid on results, for he would be very pleased to have not only a professional, but a financial interest in getting the best results possible. He adds that the guarantees to effect economies which he gave the Council he has made more than good. The books and records show that it was not he who, as alleged, put false statements before the Council. The undertaking is not, he asserts, the hopeless thing one would imagine from the reports. He attaches to his letter an appendix, in which he deals, in technical detail, with the points stated in Mr. D'Alton's report.

Eccles.—Bulk Supply.—The Corporation has decided to inquire from the Salford Corporation and the Lancashire Electric Power Co. as to their terms for supplying electrical energy in bulk.

India.—According to *Indian Engineering*, the Government Resolution on the Report submitted by the Committee appointed in June last to advise Government on the question of the charges at present levied by the Calcutta Electric Supply Corporation, Ltd., will be received with general satisfaction. With rebates for prompt payment the present cash rates for current are 5 annas for lighting and 3 annas for fans, with further reductions in the case of large consumers, while the meter rent was reduced from Re. 1 to 8 annas in 1915. The Committee, after considering the case in all its bearings, recorded the following opinion:—"We cannot but come to the conclusion that there is a sufficient margin to admit of a further reduction in the cash price per unit for lighting. There has been a reduction of 1 anna since the agitation for lower rates commenced in 1914. This reduction was, we think, unduly delayed, and it would have been more fitting if the additional profits had been utilised in working out the loss on the old plant rather than increasing the dividend of the shareholders." With this expression of opinion the Government Resolution fully concurs.

Keighley.—Street Lighting.—A proposal to spend £300 on the further lighting of the streets by electricity, has been referred back by the T.C.

Leigh.—Linking-up.—The T.C. has confirmed a proposal by the Electricity Committee to link-up its undertaking with that of the South Lancashire Tramways Co., for the purpose of a mutual stand-by, and also for the laying down of plant at a local works, which schemes will involve the expenditure of £2,100 and £1,440 respectively.

Lewes.—Street Lighting.—The T.C. has decided to have certain public thoroughfares temporarily wired for public lighting by electricity, at an estimated cost of £45.

London.—Marylebone.—The Electricity Committee, on the report of the general manager, recommends the reconstruction of the ash conveyor (which has been in use 11 years), at a cost of £1,590, plus £100 for labour. He has also reported on the fires which frequently occur in the overhead bunkers, and has decided that some means must be provided for quickly removing the coal which is on fire. He recommends that a conveyor should be erected under the coal bunkers in the boiler house, at a total cost of £1,700.

The general manager reports that he finds the cost which would be entailed to gasify coke in producers, extract the ammonia and turn it into sulphate, and fire the boilers with gas, would far exceed any saving that could be made.

As the next best step he recommends that two of the boilers should be fitted with the Underfeed Co.'s travelling grate, at a total cost of £2,100; the boilers are designed to evaporate normally 18,000 lb. of water per hour, and this can be increased to 25,000 lb.

A technical report on the low-temperature distillation of coal has been submitted to the Committee.

The working of the electricity department for the September quarter shows that 2,745,481 units were sold, a net increase of 3·79 per cent. over September, 1915. The revenue from consumers,

including meter rentals, amounted to £28,312, an increase of £812 on the corresponding quarter. The total expenditure for the quarter amounted to £17,413, an increase of £1,844. The result of the quarter's working is a drop of £133, as compared with 1915, but, on the half-year, it is £1,939 better than last year.

It is estimated that the lighting units have decreased by about 12½ per cent., as the result of daylight saving, further lighting restrictions, and consumers' economies since last year. The analysis discloses an increase of no less than 20 per cent. in sales for uses other than lighting, which it is expected to retain after the war.

WOOLWICH.—The General Purposes Committee has agreed to support the Hackney B.C. in defending the pending action in respect to alleged preferential charging, but urges that official action should be taken to defer the proceedings till after the war.

BATTERSEA.—The Electricity Committee recommends the Council to grant an advance of 3s. per week as war wages to fitters in the employ of the Electricity Department.

With reference to the electricity supply in the Nine Elms district, the Committee is arranging for a 300-K.V.A. transformer, to be supplied by the British Electric Transformer Co., at a cost of £368.

SOUTHWARK.—The Electricity Committee has prepared a list of revised charges, which will be equivalent to a total increase in prices since the war started of 30 per cent. on lighting and 50 per cent. on power. It is pointed out that, as revised, the charges are only equivalent to those of the competing company in the area. It is suggested that in the future an increase in price of 1 per cent. may be made for each 6d. by which the price of coal exceeds 20s. per ton.

Manchester.—PROPOSED LOAN.—The Electricity Committee proposes to apply to the L.G.B. for sanction to borrow £30,000 to cover the cost of additional plant at consumers' and Corporation sub-stations.

Mr. S. L. Pearce, the chief engineer, anticipates, in view of the increased demand, that it will be necessary to review the position with regard to the generating plant in the course of the next few months.

Portuguese East Africa.—According to the *British South African Export Gazette*, the English company holding the contract for the supply of power to the Government railway and docks at Lourenco Marques, has installed a 400-KW. generating set and two new boilers, at a total cost of £6,500, on the advice of Messrs. Mordey & Dawbarn, the consulting engineers.

St. Annes-on-Sea.—ELECTRIC HEATING.—Mr. J. H. Clothier, the electrical engineer to the District Council, reports that during the past month there has been quite a run on electric radiators, householders turning to this form of heating in preference to the now costly coal fire. The result has been that the load has been particularly heavy, constituting a record.

Sheffield.—LOAN SANCTION.—The Treasury has approved of the borrowing of £8,280 for rotary converters and sub-station buildings, including cost of purchase of a site for the sub-station.

NEW POWER STATION.—A public meeting of ratepayers has approved the proposed new power-station scheme; it was pointed out that the electric furnaces in use or ordered represented an output of 100,000 tons of steel per annum.

Southport.—The Corporation Electricity Committe has instructed the Town Clerk, Borough Treasurer, and Electrical Engineer to draw up new regulations with reference to electricity supply.

Swansea.—HIRE-PURCHASE SCHEME.—The Corporation has approved of a recommendation of the Electric Lighting and Tramways Committee, as the best means of encouraging the supply of electricity to houses and premises where the occupiers are unable, or unwilling, to bear the initial cost of installation, to supply the electrical apparatus, do the wiring, &c., on the hire-purchase system. The scheme is applicable to electrical apparatus of all descriptions obtainable at the Committee's showrooms, upon a cash payment of 20 per cent., the balance to be paid by means of quarterly instalments spread over three, five or seven years. The cost of installing a house varies from £3 12s. 6d. for one of five rooms, to £6 12s 6d. for one of ten rooms, and the payment of the cost of the installation and fittings is to be charged to a suspense account, which will be reduced year by year as the instalments are repaid.

Walsall.—The maximum load recorded at the old Wolverhampton Street station on December 13th last was 2,006 KW., the effective plant capacity being 1,870 KW. The original war wages of the electricity and tramways departments have been increased from £411 and £1,300 to £822 and £2,075 respectively.

Owing to the delay in getting the new generating station into full use, the Electricity Committee has decided to increase the price of current by 20 per cent., as from the meter readings for the December quarter.

Wimbledon.—LOAN REFUSED.—The B. of T. has refused to sanction a loan of £3,483 for house mains, services, meters, and a sub-station transformer. The Council has decided to inform applicants for connections of this fact.

Winchester.—PRICE INCREASE.—The T.C. has increased the price of current as from the Christmas quarter for lighting, power, heating, and cooking by another 10 per cent., making 25 per cent. since the war broke out.

TRAMWAY and RAILWAY NOTES.

Astley.—A correspondent states that the proposed new tramway through the Astley district—where extensive new coalfields are being opened out—which would connect with the South Lancashire Co.'s system at Leigh and Boothstown, has been shelved until after the war.

Bradford.—The tramway authorities are inviting employers of the city to change the meal times of their staffs in such a way that the meal hours will be spread over a wider period than at present, in view of the increased demand on the cars consequent on the railway restrictions, and also of the limit on the number of cars available owing to the action of certain workmen in refusing to work overtime.

The traffic receipts up to the present time—quite apart from the increased use of the cars by reason of the railway restrictions—amount to £10,000 more than for the corresponding period of last year, and last year was unusually high. About 600 men have been released from the staff of car operators for the Army or war work, to attempt to replace whom the department has secured 300 women as conductors. The sheds have been combed and re-combed for men fit to be trained as drivers, and the repair department has lost 84 men to the Army or war work. The men left have not, unfortunately, been able to appreciate their responsibility to quite the extent which is desirable under present circumstances, and the decision of the local Munitions Court having gone against them in a recent dispute on rates of pay, they are refusing to work overtime. The renewals and building department of the undertaking, owing to war effects, has practically ceased to exist, and the number of cars which can be put on the road is greatly reduced, to cope with greatly increased traffic. The normal week-day number of cars is 176, but the number possible is now about 156, and whereas the Saturday service is normally 196, it is now reduced to 164.

ACCIDENT.—On Monday morning a car, from which the driver had alighted, ran away down a steep hill, colliding with another car and wrecking it; 21 passengers were more or less seriously injured.

Darlington.—The tramways have now completed their 11th year, and in the annual abstract of accounts it is stated that the gross profit for the past year was 6·5 per cent. on the capital outlay of £77,929, compared with 5·8, 5·3, 4·4, and 4·4 per cent. for the previous four years. After providing for interest and depreciation, there was a net loss of £1,088. The working costs per mile were almost the same as in the previous year. The passengers carried numbered 4,439,278, an increase of 204,495 on the previous year, and the traffic receipts showed an increase of £963.

Doncaster.—WELDED JOINTS.—The Tramways Committee has appointed the Tudor Accumulator Co., Ltd., to carry out the work of welding and building not less than 250 rail joints on the Corporation's permanent way. The track has given considerable anxiety for some time, and £5,000 has been spent on it during the past financial year.

Referring to war-time difficulties last week, Councillor Balmforth said that they had had to resort to women drivers and conductors, who had done so well that he did not know whether the men would not be in the second place at the finish of the war; 36 Saturday drivers had been trained, and something like 85 women, 28 of whom had left at various times. The department required more cars, but could not get them, and the number they had were running full time, and could not be laid by for overhauling. There was difficulty in getting repair parts, and some cars had had to be pulled to pieces to effect repairs on others. In regard to an application for cheap workmen's fares, he said that in the near future fares might have to be increased.

Dudley.—ACCIDENT.—On Thursday morning, last week, a serious tramway accident occurred on the Tipton Road route, resulting in the death of one person and injuries to 25 or 30 others. The accident was almost a repetition of one which occurred in the same place a year ago. The driver left the car for a few moments at a terminus, while the conductress turned the trolley pole and mounted the rear platform, when the brakes were apparently released, and the car ran away uncontrolled down an incline, being derailed at some points and overturned. Of the passengers 25 were taken to the hospital, while one—an extra conductress who was learning—was caught under the car and died shortly after rescue.

Huddersfield.—Mr. E. H. Sellars, the Chairman of the Tramways Committee, has made a public appeal for patience and forbearance during the present stress and difficulty in the tramway service. The department has lost 180 men to the Army or to war work, and the whole of the works staff has been combed to find suitable men to train as motormen. The number of stopping places on the routes is to be materially reduced, and the public are asked not to require parcel carrying after 5 p.m. Ladies are asked to use the cars for shopping at times other than workers' meal times.

Keighley.—WOMEN DRIVERS.—The Corporation has decided to abandon its experiment of employing women drivers on the electric cars. One or two minor accidents have occurred, and it is said the women have not the necessary muscular power effectively to apply the brakes.

The question is to be considered as to whether it is feasible for the tramway system to be linked up to that of Bradford through Bingley and Crossflats by petrol omnibuses.

Lancashire Tramway Wages.—As a result of an arbitration conducted by Sir George Askwith, a war bonus of 6s. 6d. per week has been granted to the male tramway employes of 14 Lancashire towns, that amount to include any increases granted since the outbreak of the war. Youths under 18 are to receive a war bonus of 3s. 3d. The award makes no change in the wages or war bonus paid to female employés. Among the areas affected are Birkenhead, Salford, Wigan, Stockport, Oldham, Preston, Bolton, Accrington, and Ashton-under-Lyne.

Sheffield.—Application is to be made to the Ministry of Munitions for a permit to have 400 tons of tramway rails rolled.

South Lancashire.—A new system of tickets with the stages numbered was introduced at the beginning of this week by the South Lancashire Tramways Co.

Miners wishing to enter the South Lancashire Co.'s cars in the afternoon, at Walkden, now form queues.

THE CONDENSATION PUMP.

In the *General Electric Review* for December, Dr. Irving Langmuir, of the Research Laboratory of the General Electric Co., Schenectady, N.Y., describes a new form of mercury vapour vacuum pump, characterised by its extreme speed and the high degree of vacuum attainable.

The original type of pump is shown diagrammatically in fig. 1.

In this device a blast of mercury vapour passes upward from the heated flask A through the tubes B and C into the condenser D. Surrounding B is an annular space E connecting through F and the trap G with the vessel to be exhausted. The tube C is enlarged into a bulb H just above the upper end of the tube B. This enlargement is surrounded by a water condenser J, from which the water is removed at any desired height by means of the tube K, which is connected to an aspirator. The mercury condensing in D and H returns to the flask A by means of the

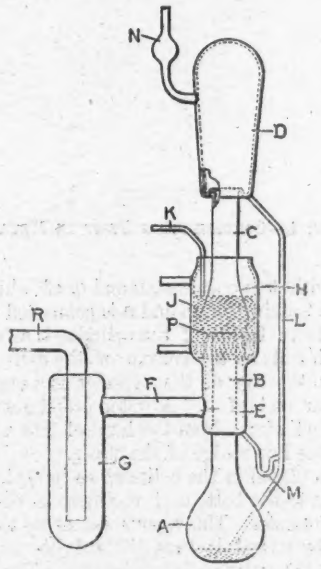

Fig. 1.—First Form of Condensation Pump.

tubes L and M. The tube N connects to the "rough" or "backing" pump, which should maintain a pressure considerably lower than the vapour pressure of the mercury in A.

This pump operated extremely satisfactorily, but was rather difficult to make. Trouble was frequently experienced by some liquid mercury collecting at the bottom of the annular space E. This mercury by being in contact with the hot tube B, gave off vapour which produced a blast passing upwards into the annular space E. Some of this mercury vapour flowed out along the tube F and interfered with the free passage of gas from F into the pump.

To avoid this difficulty the design shown in fig. 2 was adopted. In this pump mercury vapour from the flask A is carried through the thermally insulated tube B to the nozzle L. The vessel to be exhausted is connected to B. The gas from this vessel passes through the trap G and the tube F into the annular space E. At P this gas comes into contact with the mercury vapour blast issuing from the nozzle L, and is thus forced outward and downward against the walls of the tube C, and is finally driven down into the space D, from which it escapes into the rough pump connection N. The mercury which condenses on the sides of the water-cooled tube C passes back through the tube M into the boiler A.

By this construction none of the mercury which condenses passes into the annular space E, and thus the troublesome blast of mercury into the tube F is wholly avoided.

In the pump shown in fig. 1, a part of the mercury vapour condensed on the walls of the enlargement H, but the larger part passed up into the air-cooled condenser D. In the newer pump (fig. 2) the enlargement of the tube C and the second condensing chamber are eliminated entirely. This greatly simplifies the construction without materially affecting the operation of the pump. It is true that the speed of operation appears to be somewhat higher in the type containing the enlargement, but the speed of these pumps is usually so excessive, even without the enlargement, that a further increase in speed serves no useful purpose.

In order that the pump may functionate properly it is essential that the end of the nozzle L (fig. 2) shall be located

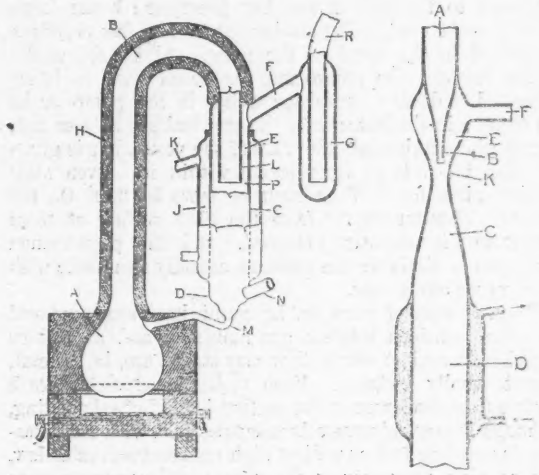

Fig. 2.—Improved Form of Condensation Pump.

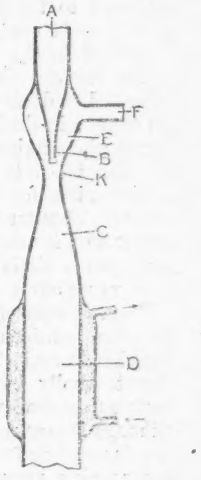

Fig. 3.—Diagram Illustrating the Action of an Ejector.

below the level at which the water stands in the condenser J. In other words, the overflow tube K must be placed at a somewhat higher level than the lower end of the nozzle, as is indicated in the figure. The other dimensions of the pump are of relative unimportance. The distance between L and D must be sufficiently great, so that no perceptible quantity of gas can diffuse back against the blast of mercury vapour, and so that a large enough condensing area is furnished.

The pump may be made in any suitable size. Some have been constructed in which the tube B and the nozzle L were $1\frac{1}{4}$ in. in diameter, while in other pumps this tube was only $\frac{1}{4}$ in. in diameter, and the length of the whole pump was only about 4 in. The larger the pump the greater the speed of exhaustion that may be obtained.

In the operation of the pump the mercury boiler A is heated by either gas or electric heating, so that the mercury evaporates at a moderate rate. A thermometer placed in contact with the tube B, under the heat insulation, usually reads between 100° and 120° C. when the pump is operating satisfactorily. Under these conditions the mercury in the boiler A evaporates quietly from its surface. No bubbles are formed, so there is never any tendency to bumping.

Unlike Gaede's diffusion pump, there is nothing critical about the adjustment of the temperature. With an electrically-heated pump in which the nozzle L was $\frac{1}{8}$ in. in diameter, the pump began to operate satisfactorily when the heating unit delivered 220 watts. The speed of exhaustion remains practically unchanged when the heating current is increased even to a point where about 550 watts is applied.

The back pressure against which the pump will operate depends, however, upon the amount and velocity of the mercury vapour escaping from the nozzle. Thus, in the case above cited, with 220 watts, the pump would not operate with a back pressure exceeding about 50 bars,* whereas with 550 watts, back pressures as high as 800 bars did not affect the operation of the pump.

The "speed" of a pump is determined by the time taken to reduce the pressure in a chamber of given capacity by a known fraction, and is measured in cm.^{3} per second; in the case of a piston pump this is approximately equivalent to the piston displacement per second. Mechanical high-vacuum pumps have speeds not greater than 100 to 200 cm.^{3} per second, though Gaede's molecular pump gives a maximum speed of about 1,300 cm.^{3} per second. Leakage back through the pump renders the degree of vacuum attainable dependent, to some extent, upon the exhaust pressure into which the pump discharges; in the case of Gaede's molecular pump, the ratio between the exhaust pressure and the lowest attainable intake pressure is about 50,000 : 1. The rate of flow of gases through tubes at pressures so low that the collisions of the gas molecules with each other are of relatively rare occurrence compared with the collisions between the gas molecules and the walls of the tubes ("molecular flow") depends directly upon the diameter of the tubes, which offer a relatively enormous resistance to the flow at very low pressures; hence large tubes must be used. The attainment of very low pressures is limited by the speed of the pump and the size of the tubing between the pump and the vessel that is being exhausted, and also by leakage either in the pump or in the vessel; in the latter case, the gas leaking in does not, in genera', pass through the walls of the vessel, but is given off from its walls or from bodies within it. Even after heating glass for half an hour or more to 360° C., the evolution of water vapour from the glass surface at room temperature is not entirely stopped. It is this phenomenon that puts a limit to the pressure actually attainable with mercury vapour pumps.

For a number of years Dr. Langmuir has been convinced that the collisions between gas molecules and a solid or liquid body against which they may strike, are, in general, almost wholly inelastic. Each molecule which strikes a surface thus condenses on the surface instead of rebounding, although it may subsequently re-evaporate. This condensation takes place just as well at high temperatures as at low, but at high temperatures the re-evaporation may occur so soon that it is difficult to detect the condensation. In this case, the condensed molecules constitute an adsorbed film. The condensed particles, before they re-evaporate, are held to the surface by the same kind of forces as those which hold solid bodies together. This leads to a theory of adsorption which is in excellent agreement with experimental facts. It was by a direct application of these ideas that he was led to construct a high-speed mercury-vapour pump.

An ejector such as is shown in fig. 3 could not be used to produce a high vacuum. Suppose, for instance, that a blast of mercury vapour passes through the tube A and escapes from B into the exhausted chamber C, and condenses at D. A large fraction of the atoms of mercury vapour escaping from B will have transverse velocity components, so that they will strike the walls of the outer tube at K. These will condense, but the heat liberated will cause the walls to assume a temperature comparable with that of the mercury vapour blast. The condensed mercury will, therefore, evaporate approximately as fast as it condenses. The atoms which evaporate are just as likely to leave the surface in a direction towards E as towards C. Therefore a large fraction of the mercury vapour which strikes the wall K will pass into the tube E and out through F, so that it will completely prevent the entrance into E of a gas at low pressures. Experiments have subsequently proved that this is exactly what happens when it is attempted to operate an ejector at very low pressure. Not only does the device fail to pump, but it is often impossible to get any gas to pass through the device, even when there is a pressure of 100 bars or more at F and the pressure at D is held at one bar or less.

If it had been assumed that the mercury atoms striking K were reflected into E, then there would be no obvious means of preventing this reflection. Dr. Langmuir was convinced that reflection did not occur, and, therefore, that to avoid this blast of mercury vapour into E, it would only be necessary to cool the walls of the outer tube at the point K. In this way, the blast of gas into E is made to disappear, and the gas from F therefore passes into E and towards K. Beyond the nozzle B the molecules of this gas are struck by the atoms of mercury escaping from B, and are forced outward (not drawn inwards) against the walls of the outer tube at K. The gas molecules are then subjected to a continual bombardment from mercury atoms, which have velocity components in the direction towards C. If the walls of the tube C are also water-cooled, the gas which enters at F is thus pushed along the walls of C, and is finally driven into the condenser D.

This was the reasoning which led to the construction of the type of pump shown in fig. 1. The very first pump constructed operated perfectly satisfactorily, and gave a speed of about 1,800 cm.^{3} per second.

The action of the pump is based on radically different principles from that of the ejector. The most essential element in the operation seems to be the condensation of the mercury vapour at K and the maintenance of a temperature in this region so low that the condensed mercury does not re-evaporate. It is, therefore, suggested that pumps based on this principle should be called condensation pumps.

The condensation pump lends itself admirably to construction in metal. One type of pump which has proved relatively simple in construction and efficient in operation is shown diagrammatically in fig. 4. A metal cylinder A

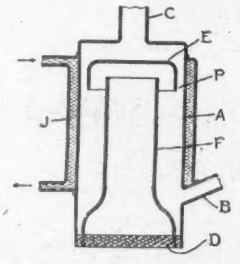

Fig. 4.—Condensation Pump in Metal.

is provided with two openings, B and C, of which B is connected to the backing pump and C is connected to the vessel to be exhausted. Inside of the cylinder is a funnel-shaped tube F, which rests on the bottom of the cylinder A. Suspended from the top of the cylinder is a cup E, inverted over the upper end of F. A water jacket J surrounds the walls of the cylinder A from the level of B to a point somewhat above the lower edge of the cup E.

Mercury is placed in the cylinder, as indicated at D. By applying heat to the bottom of the cylinder the mercury is caused to evaporate. The vapour passes up through F and is deflected by E, and is thus directed downward and outward against the water-cooled walls of A. The gas entering at C passes down between A and E, and at P meets the mercury vapour blast, and is thus forced down along the walls of A and out of the tube B. The mercury which condenses on the walls of A falls down along the lower part of the funnel F, and returns again to D through small openings provided, where the funnel rests upon the bottom of the cylinder.

Pumps of this type have been made in several different sizes. A pump in which the funnel F is 3 cm. in diameter, and the cylinder A is 7 cm. in diameter, gives a speed of exhaustion for air of about 3,000 cm.^{3} per second, and will operate against an exhaust pressure of 200-(00 bars, depending on the amount of heat supplied to the mercury. The power consumption ranges from 100 to 500 watts.

Very small pumps have also been constructed in which the tube F is only 0·6 cm. and the cylinder A is only 2 cm. in diameter. This type of pump gives a speed of about 200 cm.^{3} per second.

* The bar is the C.G.S. unit of pressure: one dyne per sq. cm. One bar is equal to a pressure of ·00075 mm. of mercury, or about one-millionth of an atmosphere.

It must be realised that the condensation pump, like any mercury pump, does not remove mercury vapour from the system to be exhausted. The vapour pressure of mercury at room temperature is in the neighbourhood of two bars. By inserting a trap such as that indicated at G (in fig. 2), between the pump and the exhausted vessel, this vapour pressure may be lowered.

For a very large number of experiments, the presence of mercury vapour is not injurious. By the use of solid CO_2 or liquid air the mercury vapour may be entirely eliminated.

By means of a new type of vacuum gauge devised by Dr. A. W. Hull, pressures as low as 10^{-5} bar, obtained by the condensation pump, have been measured. There is little doubt but that pressures very much lower than this can be, and have been, obtained by cooling the bulb to be exhausted in liquid air, so as to decrease the rate at which gases escape from the walls.

THE POSITION OF THE SHIFT ENGINEER AFTER THE WAR.

By JOHN MARKS.

Since war broke out, the shift engineer has been declared to be indispensable, badged, and sternly prevented from following his one-time wandering propensities in search of better jobs (off shift).

Previous to the war, complaints were rife from the whole body of shift engineers that they were grossly underpaid, and in many cases treated worse than the workmen; in far too many cases this was true, and many remedies were suggested for the very undesirable state of things then existing.

The writer, who did many years' shift duty in important plants, has always taken a keen interest in the welfare of the station man, and particularly of the men on shift; on many occasions prior to the war, he maintained, against his colleagues, that the best policy was not to try to mend matters, but to end them by leaving station work altogether. Though the reasons for this view were simple, and founded on facts which could not be disputed, yet the writer found the majority of station men against him when he declared that the only way to better things was to get out of the line.

It should be obvious to any man who will study the financial returns of the large power companies for an hour or two, that to expect comfortable berths, having adequate salaries attached to them, from the central-station line, is to expect the impossible. The money earned is not sufficient to pay a return to the shareholders, let alone be generous to the officials; and until the companies concerned do pay substantial dividends for a series of years, there will be nothing but low pay and overwork for every engineer connected with the central-station industry, from the top to the bottom, in both municipal and company work.

This fact presses especially hard on the shift engineer, whose work by its nature is inconvenient socially, and often debars a man from intercourse with members of his own and kindred professions.

This would be but a slight disadvantage if the remuneration and prospects were reasonable; but good pay cannot come where profits are lean or non-existent, and prospects cannot be lively when there are literally many hundred well-qualified men holding positions inferior to their abilities; whilst, at the same time, the tendency is for the number of officials and men required in the industry to diminish consequent on the increased size of individual generating sets, and the present fashion for very large stations supplying wide areas.

The shift engineer must maintain the supply, often with plant badly overloaded and in need of repair, and must also be prepared to turn out the unit on his particular shift for the least possible expenditure.

On top of these advantages, he enjoys the privilege of night and week-end duty, and is also permitted to be blamed for any little untoward happening, which may be discussed whilst he is not present. The above list of drawbacks is by no means exaggerated, and yet it is possible to find many shift men who delude themselves with the idea that a good berth will come their way if they only wait long enough.

Now, though the shift man's duties are responsible, yet they are mostly of a very routine nature, requiring steady day-by-day application to many small details, rather than original thought or brilliant ingenuity; in fact, in some ways a clever man would be a nuisance as a shift engineer. He was all right in the days when things were new and little understood, and when a really good technical education was necessary in order to permit him to visualise rapidly what was developing when things went wrong, and so to check or remedy the same as soon as possible; but that day has passed. Consequently, we have a second good reason why the shift engineer cannot expect his remuneration to mount very high, and shift men will be wise to recognise that men of quite mediocre talents and training can, and do, run shifts successfully, year in year out, in quite large plants.

Then, again, the station man is unorganised, and experience teaches that unorganised occupations are never paid well, or even treated considerately, unless they are occupations for which few men can compete.

The writer does not consider that organisation will do much for the shift man, for two reasons. The first is that, to the type of man now in mind—namely, the man brought up and sent into engineering as a profession, £250 to £300 a year is a pittance, and not a living. Now neither in company nor in municipal work will the shift man's salary ever go above the higher limit, and in the great majority of cases it will not reach the lower figure. The writer constantly comes across men on the verge of, or just over, 40 years of age, who will not see that with men only a year or two their seniors, or in some cases not their seniors at all, in the superior jobs, there will be no possible chance of these jobs falling to them until they are too old to be considered, or to enjoy them if they should achieve them. Such men cannot deny the position when it is pointed out to them, but merely content themselves with getting cross over the matter, and seeking to delude themselves as to the facts.

The second reason is that amongst station men there is far too much snobbery, as to their being above belonging to a protective association; as if they were better than doctors or lawyers, and as if there can be any dignity in belonging to a profession in which underpay and overwork is the rule! There is practically no spirit of loyalty between man and man; in fact, often the reverse. And the contrivings to get the superintendent or chief to lunch at their homes, or spend the evening there, would be laughable if they were not so contemptible.

Then, again, the doctors or lawyers can enforce their demands by making matters unpleasant for those who quarrel with them, and they have done so. With the shift man, however, the case is different; his job can be kept going, if need be, by the older officials working the station until strike-breakers can be obtained. These chaps would be available in 10 days on the offer of a salary of 50s. a week. Thus, whilst the work does not lend itself to high salaries or pleasant conditions, its present economic state makes it impossible for its members to enforce their demands.

Hence, once again, the policy is to get out of station work into some sphere in which one's abilities will render one too valuable to be readily dispensed with; in such cases both money and power can be obtained. They can never be obtained, however, in any routine type of berth, and shift engineering is undoubtedly routine to a great extent.

At the present time, chiefs are wanting shift engineers, and one of them recently pleaded at a Tribunal Court that shift engineers were being advertised for in *thousands*. As a matter of fact, there were consideraby less than 100 such advertisements in the columns of the Review that week. Still, the men are wanted at present.

In such a case one would expect to find a greater salary than was offered before the war, or than will be normal after

the war, when so many more men will be available. What do we find? That the very large majority of such places offer less than 50s. a week salary; that many of those offering that pittance (with war bonus) state that the appointment is for the war only, whilst the appointments at or above the level of £200 a year are so rare as to be cause for wonder and comment.

If this is what is offered now in a time of want, what will be the case when shift men are once more as plentiful as dead leaves in October? Another feature which must be considered is the fact that long before the war, chiefs up and down the country were offering shift jobs to men of a very different class to that drawn upon, say, 10 years ago. Twelve months before war broke out the writer knew young fellows who had never done anything more than act as engine-room lads, to obtain shift jobs, and, what is more, hold them. These cases were carefully noted, and it was also found that they were by no means isolated. The jobs tackled, to the writer's knowledge, included both three-wire D.C. and three-phase work; in at least one case the man who tried for, and pulled off, the job, certainly stretched the truth in order to secure the berth; whilst in another case that the writer knew of, the man made a full statement to the chief that he knew but little of the electrical side of the work.

The important point is that such men have not only obtained, but have held, such appointments, and have gone from one station to another and held their jobs amongst strangers.

It should be borne in mind that lads such as these have been brought up on incomes of, as a rule, less than £2 per week; consequently, when they work up into a position carrying, say, 45s. or 50s. a week, in peace time, they have satisfied their ambition as regards obtaining what they describe as a good job, especially when they have been accustomed to losing their wages if they were off sick; whilst the privilege of 10 or 14 days' holiday with pay also enhances the attractiveness of the post.

Consequently, the chief employing them is pleased by obtaining a man who will settle on a low wage compared with what the usual type of engineer expects to earn; he is also relieved from the bother caused by his shift engineers always being on the move, in search of appointments carrying salaries on which they can live. The engine-driver type of lad who has got himself into a shift job *can* live on the screws usual to the business.

It is possible that when a good many of these men are employed up and down the country they will join up with, say, an engine-drivers' Trade Union; and from this point of view there may be interesting developments in store for the chiefs who have encouraged such men. In many places with which the writer is in touch, the shift engineer mixes socially with the drivers; the writer does not refer to the works' football team meetings as social meetings, but to the fact that in many cases they actually live in the same districts, even the same streets, and knock about together for the greater part of their spare time.

This may be quite all right, or it may not, according to the view a man takes of his position. Every man must settle this matter for himself; but, when this sort of thing can be found in a good many towns, the sensible shift engineer who has come into engineering as a profession will recognise that a job of this type is no job for him. In fact, the writer believes that before many years are run, the shift-engineer position will be that of a foreman, and not an official. Consequently, the wise policy is to go into the work for the sake of the experience to be gained, and to get out of it at any cost after three years.

The writer expects criticism, but would ask his critics to remember that all the above statements are statements of fact, and the direct outcome of first-hand experience by the writer.

Academy of Sciences.—The Académie des Sciences has awarded the following prizes for electrical progress:—Plumey Prize to Prof. Louis Barbillion, of Grenoble; Kastner-Boursault Prize to Prof. Eric Gérard, of Liège (posthumous award); Hébert Prize to M. J. Lemoine; Hughes Prize to M. L. Chaumont (killed in battle); Henri de Parville Prize to M. E. Montoriol. Many of the other prizes were awarded to men who have fallen in the war.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—Feb. 19th. Municipal Council. Meters, maximum-demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

MELBOURNE.—January 31st. Department of the Navy. Dynamos, switchboard, motors, balancers, and control gear, for Flinders Naval Base. Specifications from the Director of Naval Contracts, Melbourne.*

March 5th. Council. One 7,500-K.V.A. turbo-alternator. See "Official Notices" January 5th.

Bambridge.—February 3rd. Urban Council. Public lighting of the district with gas or electricity.

Middlesbrough.—February 1st. Corporation. Twelve months' supply of electric lamps. Mr. S. E. Burgess, Borough Engineer.

New Malden.—January 31st. Malden and Coombe U.D.C. Installation of fire-alarm system. Particulars from the Council's Engineer.

New Zealand.—TAURANGA.—February 12th. Borough Council. Supply of six three-phase transformers, 11,000-400 volts. Messrs. H. W. Clime & Sons, Consulting Engineers, Raetihi.—*N.Z. Shipping and Commerce.*

South Africa.—DURBAN.—February 12th. Six four-ton electric travelling portable jib-cranes for the harbour.*

Spain.—January 29th. Municipal authorities of Monterrubio de la Serena (Province of Badajoz). Concession for the electric lighting of the town during a period of 16 years.

The municipal authorities of Fuente del Arco (Province of Badajoz) have lately invited tenders for the concession for the electric lighting of the town during a period of two years.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Colchester.—T.C. Tramcar brake blocks; Messrs. Pasley and Co.

Glasgow.—The Electricity Committee recently received tenders for one 6,000-KW. turbo-alternator set, with relative condensing plant, to be put down at the Port-Dundas station, for the winter of 1917-18. The offer by the British Westinghouse Co., at £20,500, for the turbo-alternator, with condensing plant to be manufactured by the Mirrlees Watson Co. at £8,045, has been accepted, this offer being the lowest.

Horsham.—U.D.C. Pritchett & Gold and E. P. S. Co., maintenance of new station battery for 10 years, at £45 per annum.

Leigh.—The tender of Messrs. Bruce Peebles & Co., Ltd., for a 250-KW. "La Cour" motor-converter for £1,225, has been accepted by the T.C.

London.—MARYLEBONE.—The B.C. is recommended to accept the following tenders:—

Reconstruction of ash conveyor, £1,690.—Messrs. Babcock & Wilcox, Ltd.
Coal conveyor under bunkers, £1,190,—Messrs. Babcock & Wilcox, Ltd.
Cast-iron parts, £265.—Messrs. Jas. Oakes & Co.
Underfeed grates to two boilers, £1,781.—Underfeed Stoker Co., Ltd.

Manchester.—The Electricity Committee. Accepted tenders:—

Erith-Riley stoker.—Erith's Engineering Co., Ltd.
Steelwork.—Redpath, Brown & Co., Ltd.
Transformers.—Ferranti, Ltd.
Cables.—British Insulated & Helsby Cables, Ltd.; Pirelli General Cable Works, Ltd.

Sheffield.—Tramways and Motors Committee. Accepted tender:—British Thomson-Houston Co., Ltd., for 50 tramcar motors.

The Electric Supply Committee has accepted the following quotations:—

R. White & Sons.—Extending ashes roadway at Neepsend power house, £1,096.
A. Reyrolle & Co., Ltd.—Eight sets of panels of sub-station switchgear, £4,041; six panels of 3,300-volt, three-phase sub-station switchgear, £750.
Vickers, Ltd.—Two 750-KW. rotary converters for augmenting the supply of electricity for tramway purposes, £2,444, plus 5 per cent. for contingencies.

The Health Committee has placed an order with Edison Accumulators, Ltd., for five additional electrical vehicles for refuse collection, at the following prices:—One at £1,264, four at £1,066 each.

The Water Committee has purchased a second-hand motor-generator, with starter, from Mr. C. L. Turner, for £77.

Sunderland.—The Council, on Wednesday, accepted the following tenders:—

Armstrong, Addison & Co.—Wood troughing.
Wooliscroft & Son.—Earthenware cable supports.
J. W. Thompson.—Cast-iron joints, troughs.
B.I. & Helsby Cables, Ltd.—Copper rod.
R. H. Longbotham & Co., Ltd.—Purchase of second-hand plant.

Twickenham.—The U.D.C. has accepted the tender of Messrs. Stuart & Moore to install five call-bells for £48 11s. 3d.

FORTHCOMING EVENTS.

Birmingham and District Electric Club.—Saturday, January 13th. At 7 p.m. At the Swan Hotel, New Street, Birmingham. Annual meeting.

Chief Technical Assistants' Association.—Saturday, January 13th. At 3 p.m. At the Tavistock Hotel, Covent Garden, W.C. Discussion on "The First Principles in connection with the Design and Lay-out of Plant for Central Stations," to be opened by Mr. Heaviside.

Association of Supervising Electricians.—Tuesday, January 16th. At 7.45 p.m. At St. Bride's Institute, Bride Lane, E.C. Half-yearly meeting and informal discussions.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, January 16th. At 7.30 p.m. At the Engineers' Club. Paper on "The Principles Involved in Computing the Depreciation of Plant," by Mr. F. Gill and Mr. W. W. Cook.

(Birmingham Local Section).—Wednesday, January 17th. At 7 p.m. At the University, Edmund Street. Paper on "Principles Involved in Computing the Depreciation of Plant," by Mr. F. Gill and Mr. W. W. Cook.

Illuminating Engineering Society.—Tuesday, January 16th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Discussion on "The Lumen as a Measure of Illuminating Power," to be opened by Prof. J. T. Morris.

Chemical Society.—Thursday, January 18th. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Belfast Association of Engineers.—Thursday, January 18th. At 7.45 p.m. At the Municipal Technical Institute, College Square. Paper on "Electric Lifts for Land and Shipboard," by Mr. C. G. Major.

Greenock Electrical Society.—Thursday, January 18th. Visit to the Brewers' Sugar Co., Ltd. (Cereals Works), Westburn Square. (Meet at 7.30 p.m.)

Royal Institution of Great Britain.—Friday, January 19th. At 5.30 p.m. At Albemarle Street, Piccadilly. Lecture on "Soap Bubbles of Long Duration," by Prof. Sir James Dewar, F.R.S.

Institution of Mechanical Engineers.—Friday, January 19th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. General meeting.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, January 20th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Modern Switch and Fuse Gear: Its Defects and some Suggested Remedies," by Mr. A. McPhail.

NOTES.

Mr. F. L. Rawson.—The issues of the *Daily Mail* of the 6th, 8th, 9th, 10th and 11th inst. contain articles "from Harold Ashton" describing the most recent activities of Mr. Frederick L. Rawson, who "does an enormous business in Divine healing on the astonishing system of prayer on a sliding scale of payment." It is an old theme, to the tune of those "with plenty of money and no brains" having been produced for the benefit of those "with plenty of brains and no money"; but the up-to-date application of the "astonishing system" is an interesting variation on the old theme. It recognises that prevention is better than cure, and provides for immunity from shot and shell. Brief reference is made to Mr. Rawson's earlier activities in "science and speculation," including the Elmore Companies. Should Mr. Ashton desire to prosecute his inquiries further into those matters, he will find the files of the ELECTRICAL REVIEW for 1890, and subsequently, quite useful sources of information. It is to be hoped that Mr. Ashton's articles may lead to further investigation and such protection as may be necessary for weak-minded members of the community.

Electric Light Switching.—The results of the Second Batch Exam. were published on page 16 of our last issue.

Foreign Trade.—THE DECEMBER FIGURES.—The official returns of imports and exports during last month contain the following electrical and machinery figures:—

	Dec., 1916.	*Inc. or dec.*	*Twelve months*, 1916 *Inc. or dec.*
IMPORTS:—			
Electrical goods, &c.	£192,756	+ £80,753	+ £556,540
Machinery	520,671	− 180,137	− 855,373
EXPORTS:—			
Electrical goods, &c.	237,795	− 20,997	+ 938,590
Machinery	1,655,029	+ 180,773	+ 1,066,837

Linking-up Electricity Works: North-East Coast.—A meeting of the North-East Coast interests was held in the Town Hall, Sunderland, on the 20th ult., Mr. A. S. Blackman, borough electrical engineer and general manager, Sunderland, presiding. The chairman, in explaining the object of the meeting, referred to the Board of Trade circular letter of May 25th, 1916, with regard to the interconnection of electricity supply stations, and also to the memorandum of the National Electric Power Supply Joint Committee, urging consideration of the question of linking-up, from the national point of view, in the interest of fuel economy. It was decided to form a Committee to go fully into the matter, and the secretary was instructed to obtain information with regard to linking-up already accomplished in other parts of the country. The Committee was appointed as follows:—Messrs. A. S. Blackman (Sunderland), chairman; H. A. Couves (County of Durham E.S. Co.); H. Ellis (South Shields); A. B. Gridley (Cleveland and Durham E.P. Co.); J. R. P. Lunn (Darlington); R. A. Scotson (Middlesbrough); R. P. Sloan (Newcastle-on-Tyne E.S. Co.); J. J. Smith (Stockton); J. W. Spark (West Hartlepool); C. Turnbull (Tynemouth), together with Mr. S. R. Windle (Sunderland), who was elected honorary secretary.

The Price of an Outrage.—The Defence of the Realm Losses Commission has been engaged in hearing a claim by the Rev. J. Dixon, of The Vicarage, Willesden, for the repayment of professional charges incurred with reference to negotiations with the North Metropolitan Electric Supply Co. and the Ministry of Munitions, in connection with the laying of an electric cable through consecrated ground, which he considered an outrage against religious feeling as long as the cable remained. The Vicar pointed out to the company that there were two alternative routes. The President (Sir James Woodhouse), according to the *Daily Telegraph* report, said that the company required, for military purposes, to lay an electric cable in the most direct way, under the pathway of the churchyard, and they so informed the Vicar. The Vicar objected. They consulted the engineers of the local authority, and there were objections to the alternative routes, which they pointed out. Ultimately they were informed that this outrage, which would take place by the use of the churchyard, could be arranged by a payment of £200 to the church fund and thirty guineas for legal expenses for a Faculty. They described it as blackmail, and refused to pay it, and the result was that the military authorities exercised the powers under the Defence of the Realm Act, and laid the cable through the churchyard. The refusal of the Vicar to consent to their doing that occasioned these costs. The whole question was how much should be paid. The outraging of religious feelings would disappear if he got enough money.

The President said he thought the less they said about patriotism in the matter the better. It was a question of money. That was clear from the correspondence. He thought the Commission took a strong view about the application. They would communicate their decision

Reconstruction Policy.—In our leading article on "Government Assistance for our Foreign Trade" (ELEC. REV. December 29th, 1916), we referred to the effect of the changes in the Cabinet on the work of the Reconstruction Committee appointed by Mr. Asquith. The following comment on the position appeared in the *Times* of yesterday:—"The Reconstruction Committee, which was appointed by Mr. Asquith last March to advise upon problems that will arise on the conclusion of the war, was placed in a difficult position by the resignation of the late Government. It was a Committee of Mr. Asquith's Cabinet, and several of its members no longer had any authority to continue their work. Mr. Vaughan Nash, however, has kept his staff together, and the routine office work of collecting material has been kept going in Dean's Yard. It is hoped that the position will be regularised in a few days' time, and it is understood that a scheme for continuing the valuable research work undertaken by the Reconstruction Committee is now before the Prime Minister. Among the important problems which the Committee referred to sub-committees, were those associated with demobilisation, industry and trade, relations between labour and capital, and education. These sub-committees, which are composed largely of experts, will presumably receive a new mandate from Mr. Lloyd George. One of the most important, Lord Balfour's Committee on After-War Trade Policy, has been summoned to meet again in a few days' time, after a long interval."

Trade after the War.—We have received a copy of the third report of the Special Committee of the London Chamber of Commerce on "Trade During and After the War." We hope to refer to the matter in a later issue.

The Use of Magnesite.—As from January 9th, the Minister of Munitions has prohibited the use of magnesite and magnesite products for, or in connection with, (1) The construction or repair of any building (other than a furnace), or any flooring or deck; or (2) the manufacture of any insulating or non-conducting material, except under and in accordance with the terms of a permit granted by the Minister of Munitions. All applications in reference to this Order should be addressed to:—Director of Steel Production (W.J.J. 342), Armament Buildings, Whitehall Place, S.W.

Appointments Vacant.—Charge engineers, electricians and engine drivers used to high-speed petrol engines, for the North of Ireland, Camp E.L. plants. See our advertisement pages to-day.

The Government and Overseas Trade.—At a meeting of the Advisory Committee to the Board of Trade on Commercial Intelligence, on Wednesday, Sir Albert Stanley, President of the Board, emphasised the importance of the Committee's work. Amongst the matters considered by the Committee were proposals for a large extension of the Trade Commissioner Service in the British Dominions, proposals for commercial missions, and other matters relating to the organisation of British overseas trade, and questions arising out of the work of the Department of Commercial Intelligence.

Electric Lamps for Policemen.—The Chief Constable has asked the Hull Corporation for the police to be made an allowance for the provision and maintenance of flash lamps of 1s. per man per month in lieu of the existing oil lamps. The Watch Committee has agreed to do so during the war.

Long-Life Tungsten Lamps.—It is well known that when a tungsten filament is operated in an evacuated bulb under ordinary conditions, the resistance of the filament gradually increases, thus lowering its temperature, and the bulb is progressively darkened by a black deposit of vaporised tungsten. Both these effects contribute to lower the efficiency and candle-power of the lamp. Heretofore, in order to increase the life of a lamp at a given efficiency, various solid halogenous compounds of low vapour tension, such as potassium iodide, have been placed in the lamp in such a position that when the filament is at normal incandescence and the bulb is well evacuated there is evolved an atmosphere which is chemically active to the metal of the filament, and which is of substantially the pressure of a first-class vacuum.

Roy Winne, of Schenectady, N.Y., has discovered that the useful life of a lamp may be further increased by placing in the bulb with a regenerative compound of the above nature, a very small amount of gas, preferably nitrogen. Ordinarily, the pressure of the gaseous atmosphere should be less than 100 microns, and usually within the range of about 10 to 50 microns, or 0·010 to 0·050 mm. of mercury.

To illustrate the effect of the novel filling combination on the life of the lamp; a 125-volt 100-watt lamp, having a drawn tungsten filament was provided with a small amount of potassium thallium chloride placed in the same way as in a vacuum lamp. The bulb was evacuated, and then enough dry nitrogen was admitted to produce an atmosphere of about 25 microns (0·025 mm. of mercury) pressure. The lamp was then sealed off and operated at a specific consumption of 0·95 watt per candle. After 1900 hours the candle-power had fallen only to 96 per cent. of its original value. During the operation of the lamp the resistance of the filament repeatedly increased several per cent., and then came back to normal. In the absence of the nitrogen the initial efficiency of a lamp of this type containing potassium thallium chloride would have fallen to about 80 per cent. in about 1,000-1,200 hours.—*Electrical World.*

The Care of Accumulators.—A South African correspondent sends us the following astonishing item from a local paper, which quotes it as a letter addressed to *The Motor*. H. M. writes:—"I have an 8-volt lighting battery, which has been standing a long time, and does not give any current, and will not charge up. I have been advised to empty it, and fill it up with spirits of salts and carbonate of soda, and then put the cells in boiling water for three hours. This, it is stated, releases the charge in the plates, and produces condensed oxygen gas. I should like your opinion on this, as a practical man told me he got the recipe from a newspaper." Exactly what the cell would look life after this strenuous course of treatment we can only try to imagine: much would depend on whether the soda was put in before the spirits of salts, or whether the mixture was made beforehand. The recipe, which reminds us of the genius who washed his watch with soap and water, and the Mad Hatter who used butter for a similar purpose, must have been invented by some cynic who had had a bitter experience with storage cells, and owed them a grudge.

New Steel Tubing Plant.—The working of a new and ingenious machine for making steel tubes automatically has been demonstrated at the works of Mephan Ferguson Proprietary, Ltd., Footscray, by Messrs. H. C. Tucker and H. M. Baker, who have purchased the sole rights for the Commonwealth from the Automatic Welding Co., of Menominee, Michigan, U.S.A. It is claimed that the invention will revolutionise the consumption of light gauge steel tubing in Australia. Plants have recently been established in America, Canada, and Japan, and the manufacturers are at present negotiating with concerns in Great Britain for the English rights.

The machine so operates that a strip of steel inserted into one end is converted at the other into a welded tube ready for the market, and cut to any predetermined length. The machine is capable of turning out 1,000,000 ft. in a year, in any size from ½ in. to 2 in. diameter, and in any reasonable shape, including circular, octagonal, square, oblong, &c. As far as is known, no steel tubing has up to the present been manufactured in Australia. The steel strip used by the machine is imported. Over £1,000,000 is spent annually by Australia in importing all classes of tubing.—*Melbourne Age.*

Educational.—Melbourne.—With a view to raising the standard of efficiency in the technical branch of the City Council's Electric Supply Department's service, the Electric Supply Committee has had under consideration a proposal to establish (*a*) a system of apprenticeship with provision for technical training; (*b*) a system of scholarships whereby the most promising of the junior engineering staff may be able to gain experience in the workshops of the best British electrical manufacturers. One member will be sent each year to Great Britain for two years' experience. It is recommended that the Council provide the successful officer with £50 for his return fare, and an allowance of £1 per week during his absence. Those chosen will be required to give a guarantee that they will return to Melbourne at the end of the term of two years. The cost of the scheme is estimated at £150 per annum.—*The Age.*

Bars for Magnetic Standards.—In a recent paper (Sc. Paper No. 295) the U.S. Bureau of Standards draws attention to the lack of uniformity met with in steel and iron standard bars used for the calibration of permeameters, and for magnetic testing generally. By means of a pair of test coils slipped over the bar, at a fixed distance apart, the departure from uniformity has been mapped out for many such bars, and in many cases large deviations from uniformity have been observed, of which no indication is apparent to the eye. Few bars show a deviation from uniformity as low as 10 per cent., which would enable an accuracy of 1 per cent. to be obtained with the apparatus used at the Bureau. It is pointed out that this method of testing for uniformity is capable of being applied to the detection of mechanical inhomogeneities and flaws, and for other purposes.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters, Chester House, Eccleston Place.—Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding:—

Monday, January 15th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25—8.

Tuesday, January 16th.—School of Arms, 6—7. Lecture, 7.15, "Company Drill," by Company Commander Fleming.

Wednesday, January 17th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, January 18th.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30.

Friday, January 19th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.23—8.25.

Saturday, January 20th.—Commanding Officer's Parade, 2.45. Uniforms, for Drill in Battersea Park.

Sunday, January 21st.—Entrenching at Otford. Parade Victoria (S.E. & C. Railway Booking Office), 8.45 a.m.

(By order), Macleod Yearsley, *Adjutant.*

Electrolytic Zinc Dust.—The sudden increase in the price of zinc dust after the beginning of the European War, owing to the cutting-off of the German and Belgian supply, led to the conducting of some experiments on the possibility of its production on a commercial scale from solutions of zinc, and the substitution of zinc made in this manner for the zinc dust ordinarily used in the precipitation of gold and silver in the cyanide process. The production of electrolytic zinc sponge seemed the most feasible method of accomplishing this object, the sponge to be of such a nature that it would crumble to dust when dried. Sodium zincate solutions allow of the deposition of zinc sponge under a widely varying range of electrical and thermal conditions. Stirring of the electrolyte must be avoided. Current efficiencies of about 60 per cent. and zinc dust precipitating efficiencies of 70 to 75 per cent. are possible. There seems to be no difficulty in getting 1 lb. of zinc dust from a solution of zinc with 3 KW.-hours of energy. Sodium zincate solution recommends itself because of its ease of preparation from caustic soda and zinc oxide, both of which are articles of commerce.—*Journal of the Franklin Institute.*

Cost of American Rural Transmission Lines.—Some data recently presented by the Committee on Overhead Lines at the N.E.L.A. Convention, is interesting as showing that many minor distribution lines in sparsely-settled districts in the States bring in little if any return on the investment they represent. More figures were not given for Eastern territories because few lines serving low-density loads are installed there, the practice being not to install lines unless a profitable load is in sight. The loss in working was not indicated with a view to discouraging supply to thinly populated districts, but to show that legislation necessitating more costly lines would be deterrent to such extensions. Ten groups of lines were analysed having a length of service of only 1·6 years, and therefore the average deficit of 8·7 per cent. on the investment, or 50 per cent. of the gross revenue, does not represent the result of the lines in full working. The total cost per mile recorded includes right-of-way, physical cost exclusive of conductors, conductors, services, street lighting equipment, &c., and overhead costs, and averages for 630 miles of line, $1,610 per mile, varying from $860 to $2,750 per mile in individual States. The annual revenue per mile of line averaged $262; individual groups of lines show averages of between $133 and $385 revenue, and of between 1,800 and 8,000 KW.-hours supplied annually per mile of line. The data, however, shows that the gross revenue return per mile of line was almost always over 10 per cent. on the cost of the line, and in three cases was over 20 per cent., and the final deficit was arrived at by assuming interest at 7 per cent.; depreciation at 8 per cent. on lines exclusive of conductors, which was taken at 2 per cent., and at 8 per cent. on services, transformers, and street lighting equipment. Operation and maintenance was reckoned at 1·5 per cent., exclusive of taxes, and the power cost in most cases was between 3 and 4 per cent. Several lines yielding a less revenue than $200 per mile show a smaller deficit (on the assumed basis) than the average on account of lower construction cost. In such cases light construction and long spans reduced the cost to, roughly, $1,000 a mile of line.

Using Power Supply for Lighting.—At the Wolverhampton Police Court, last week, John Cullwick Turtour was summoned at the instance of the Wolverhampton Corporation for having improperly used electricity.

Mr. Howell (Deputy Town Clerk), who supported the summons, said the defendant in August last applied for a supply of electricity for power purposes. Recently an inspector passing defendant's premises noticed wires about the place, and he found that the current supplied for power was being appropriated for lighting purposes. The charges for lighting were at a higher rate.

Mr. R. Dallow (solicitor), who defended, said it was a fact that the current supplied for power purposes was used for lighting. He explained that prior to November 5th the premises were lighted from a dynamo run off shafting. On November 5th a mishap occurred to the dynamo, and defendant, who was working on munitions, could not stop, and so arranged the wires to get light

from the power supply. The same day, or shortly after, a man from the electricity works called, was shown the light, and was asked to supply a second meter, which the Corporation ultimately supplied. Under the circumstances, defendant did not think he was doing any harm, and there was certainly no intention to defraud, as everything was done openly. Neither was there any idea of saving money, as a considerable sum was spent in lamps. The sole idea was to get on with the work.

After evidence had been given by Mr. Ernest Stubbs (assistant electrical engineer to the Corporation), the Stipendiary said no doubt electric current was applied wrongly, but there did not appear to have been any considerable use of it in the wrong way. However, there had certainly been a mistake, to put it in the mildest way, and defendant would be fined 40s.

Institution and Lecture Notes. — Institution of Municipal Engineers.—"Some Notes on the Uses of Electricity in Municipal Engineering" were read at the annual meeting of the Institution, on Saturday last, by Mr. Horace Boot, for the edification of municipal engineers and surveyors, the author remarking that he had been struck with the lack of general knowledge shown on several occasions. The paper indicated the various uses to which electricity could be put, but it was not suggested that the borough engineer and surveyor should be thoroughly competent in every branch; generally, the advice of Mr. Boot was to call in an expert where the municipality did not already possess one as a permanent official. In the course of a short discussion, the two or three speakers who took part concentrated upon the question of sewage pumping, and drew attention to the better results obtained by the use of small automatic electric pumping plants than by compressed air. Attention was called to the fact that a small electrically-driven centrifugal pump could be worked as efficiently as a large one, and at the same time did away with the labour difficulty, which was causing a good deal of trouble with small schemes. Mr. Reginald Brown also mentioned the Act recently obtained by the Post Office, giving compulsory powers to erect poles on private property, and complained of the injustice of allowing the Post Office to do this before arranging what compensation should be paid the owner. He also supported Mr. Boot in the belief that the telephone system of the country would be better in the hands of the local authorities.

London School of Economics and Political Science.—On Thursday, January 18th, at 5 p.m., Mr. E. J. P. Benn will lecture on "The Organisation of Trades."

Institution of Electrical Engineers.—At the meeting of the SCOTTISH LOCAL SECTION, in Edinburgh, on Tuesday evening last, a paper was read on "Principles Involved in Computing the Depreciation of Plant," by Messrs. F. Gill and W. W. Cook. The same paper was to be read in London last night.

Fatalities.—An inquest was held at Lancaster, on Friday, respecting the death of William Thomas Goodchild (50), an electrician, of Wandsworth. The evidence showed he was engaged fixing conduits in a factory near travelling cranes. In avoiding one crane he was caught by another, and crushed to death between the side of the crane and a standard. The Coroner commented on the fact that it was the third death within a short period; he said that warnings should be given to men engaged in such dangerous occupations, and if another fatality occurred he would probably recommend a criminal prosecution. The charge-hand of the electricians, John Maudsley, said Goodchild was carrying out his orders, and had been repeatedly warned about the cranes, but witness admitted that in future it would be wiser to stop the cranes when such work was being carried out. The jury agreed to a verdict of "Accidental death," and added a rider that the electrical cranes should be stopped while work of this character was in progress.

A Bradford Corporation tramway inspector, Mr. Enoch Bower, who was crushed between two cars on December 23rd, died on Saturday, aged 57.

David Davies, an electrician, whilst repairing an electric trolley at the Glamorgan Colliery, Llwynypia, received an electric shock, and, falling from the scaffolding about 18 ft. to the ground, was killed.

An inquest was held at Huddersfied, on Monday, in the case of James Chadwick (35), lead-burner, of Rochdale, who was killed whilst engaged on repairs at a Huddersfield works. The evidence was to the effect that he had arranged to attach a lamp to a flexible lead. The installation was worn, and consequently, faulty, and the deceased received a shock at the lighting voltage. The lead-burners, it was said, had three or four flexible leads, which appeared to have been made up of odd parts. In returning a verdict of "Accidental death," the jury recommended that the leads should be used only after being obtained from the electric stores.

Electrical Supplies to South Africa.—The *South African Mining Journal* for November 18th, just to hand, says:—

"On the whole, there are plenty of electrical materials in town. The British are keeping up very fair supplies, which are very necessary on account of the many standardised goods, as arranged in the various plants in the pre-war days. We are getting plenty of lamps from America, but much of their electrical material is not suited, because of the different sizes, for our general trade, and they are not laying themselves out to supply material outside their own particular sizes. This is altogether in contrast to the method adopted by the Japanese, who are doing everything they can to copy any models sent from here, in every detail and accuracy. Their efforts so far in supplying the South African market with electrical goods have been quite a success, and as travellers, and in a lesser degree speculators, are constantly travelling between here and Japan, the prospects in many directions of trade with them seems promising for great expansion."

The issue of the same journal for the previous week comments as follows on the copper position:—

"In reviewing the copper cable position, owing to the prohibition of export by the British Government, it has been gathered that the mines have fortunately provided themselves with large stocks of cables where copper wire is part and parcel of their composition. In this respect, also, the mines have ample copper wire and other copper goods to last many months, as the managers have anticipated that something was likely to happen in this direction. The prominent representatives here of the Cable Makers' Association have also anticipated the position by accumulating large stocks of cables, containing copper, in Johannesburg, as well as other copper goods. Hence the prohibition will not be felt here for a considerable time, but obviously the tendency will be to harden values for all copper material, particularly in electrical goods where copper wire is the medium for conveying the electric power and light. In commercial circles, apart from the mines and municipalties, there are ample stocks on hand to carry on with for a very long while, and substitutes are so easily procurable."

South American Telegraphs.—By a decision of the Brazilian Supreme Court, adverse to the Western Telegraph Co., the Central and South American Telegraph Co. will be enabled to lay cables from Buenos Ayres, in Argentina, to Brazil, along the Atlantic coast.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—At Barrow T.C. meeting, on Monday, there was a long discussion upon a proposal by the Electricity Committee that the salary of the borough engineer, Mr. H. R. BURNETT, should be increased from £550 to £600 per annum, to date from January 1st, 1916. It was shown how the output of the Corporation works had grown from between three and four million units to 13.8 million units last year, and would probably be 15 million units this year. Mr. Burnett had supervised most important extensions of the works, and saved the Corporation the costs of a consulting engineer. The Mayor pointed out that in a list of nine towns, with an average output of four million units, there was not a case where the engineer's salary was below £600. In one town, with an output of seven and a half million units, the salary was £700. The Council decided to increase the salary to £600, but rejected the recommendation to make it date from January 1st, 1916.

The Doncaster Corporation last week approved the appointment of Chief Inspector BAKER as superintendent traffic manager, in succession to Superintendent Strachan, who has left. Inspector FULLER was promoted to be chief inspector. There was strong opposition on the ground that, though no word could be said against the two officials concerned, the whole system of traffic management required reconstruction.

The Bradford Corporation has agreed to lend the services of Mr. C. J. SPENCER, the tramway manager, to the Government for important special work. Mr. Spencer will commence his new duties very shortly.

Increases of remuneration recommended to the Wakefield City Council include those of Mr. G. VAREY, temporary chief assistant electrical engineer (period of war), from £175 to £208; Mr. T. C. BENNETT, assistant station superintendent, £120 to £130; and Mr. C. P. SECKHAM, assistant superintendent, £109 to £117.

The Newcastle-under-Lyme T.C. has increased the salary of the electrical engineer by £25 a year.

The salary of Mr. A. W. CLEGG, acting engineer at Accrington, is to be increased from £350 to £400 per annum. He is also to be granted a special fee of £50 for loss of holidays, prolonged hours of duty, and special work in connection with the installation of the new plant. He receives a further grant of £140 from the chief electrical engineer (Mr. Gray) during his absence in the Army.

The Establishment Committee of Woolwich B.C. reported at the last meeting of the Council having had under consideration a memorandum, from the Electricity Committee, recommending an increase in the salary of the borough electrical engineer. The Electricity Committee submitted statistics showing the working of the undertaking, and the salaries paid to the electrical engineers of other London boroughs. The Establishment Committee was in agreement with the views of the Electricity Committee, and recommended that the salary of the borough electrical engineer, Mr. G. W. KEATS, be increased from £400 to £500 per annum as from April 1st, 1916. This recommendation has been adopted.

General.—The marriage took place recently at Cootehill, County Cavan, of Mr. J. J. WOODS (resident engineer and manager of the Clones Electric Light & Power Co., Ltd.) to Kathleen McCutcheon, of Market Street, Cootehill.

Lieutenant ALFRED WALKER EMPSON, A.M.I.E.E., Royal Flying Corps, is in a London hospital recovering from an operation. After war broke out he gave up his position as

chief engineer to the Merida Electric Light Corporation, Yuchatan, Mexico, and returned to England to join the Machine Section as a private. His brother was killed in action on New Year's Day.

Mr. W. RATCLIFFE-SMALL asks us to state that for the present his address is 159, Westminster Bridge Road, S.E. Telephone No.: "Hop. 4703."

Mr. H. W. BOSWORTH, who has for a number of years been on the staff of the Lancashire Dynamo & Motor Co., Ltd., has been appointed manager of their London office. His address will remain as at present, 28, Victoria Street, Westminster.

Mr. G. R. DRUMMOND, M.I.E.E., M.I.M.E., has resigned his post as electrical and mechanical engineer to the Government of Jodhpore, and rejoined the Lahore Electric Supply Co., Ltd., as general manager. The Jodhpore electric power scheme has been completed with the exception of the low-tension distribution from sub-stations, for which a good deal of copper is required, which at present is not available. Upon receipt of this copper Mr. Drummond has agreed to return to complete, test, and hand over the scheme. The total cost of the power scheme, including fairly large workshops, ice factory with large cold storage, will be 10 lacs of rupees, and when in full operation is expected to bring a return of 9 per cent. to 14 per cent. to the Jodhpore Durban.

Mr. G. L. F. PHILIPS, technical director of the Philips' Glowlampworks, Ltd., Eindhoven, has been nominated Doctor *honoris causa* by the Senate of the Technical University at Delft (Holland).

Roll of Honour.—Lieutenant H. Y. V. JACKSON, M.I.E.E., Royal Engineers, who was prior to the war on the South Wales staff of the British Westinghouse Co., Ltd., has been awarded the Military Cross for distinguished service in the field.

Sergeant WILKES, Royal Flying Corps, who was at the electric power station of Messrs. Pilkington Bros., Ltd., St. Helens, has been killed in an aeroplane accident, aged 27 years.

Private W. FORRESTER, North Staffs. Regiment, reported to be missing, enlisted from the staff of Messrs. Bullers, Ltd., of Hanley.

Corporal J. ARNOLD, West Lancashire Divisional Engineers, who has fallen in action, was engaged for 15 years at the electric light station at Rainhill Asylum, near St. Helens.

The D.C.M. for conspicuous bravery under fire has been awarded to Private GEORGE NEEDHAM, of Croydon Corporation tramway staff.

Captain C. F. D. SUGGATE, Inspector of Ordnance Machinery, has been awarded the Military Cross. Captain Suggate obtained his commission in 1914, and has been on active service for some considerable time. Previous to entering the Service, he held an appointment in the electrical engineer's department of the Great Eastern Railway Co.

Private FRED PALMER, of the Loyal North Lancashire Regiment, has died from pneumonia whilst on service. He was employed at the Manchester Corporation Stuart Street electricity works.

At the Barrow Town Council, the Mayor recorded congratulations to R. WILLIAMS, a jointer in the mains department of the electricity undertaking, on being awarded the Military Cross.

Private EDWARD OWEN, R.E., aged 23, an electrical engineer, has been killed in action.

Private STEPHENSON, formerly in the Hull Corporation electricity department, has been missing since November, when he was in action.

The *Times* reports that Second-Lieutenant W. M. NOBLE, R.E., who was the only son of Mr. W. Noble, of Herne Hill, and who was with the General Electric Co., has died of wounds, aged 26.

Private F. T. WOODS, London Regiment, formerly in the employ of the India-Rubber Co., Silvertown, has been awarded the Military Medal for gallantry in assisting an officer to capture some of the enemy's field guns, and in carrying messages under heavy fire.

"I must say I feel very proud to-day; my son has been mentioned in dispatches," said Colonel Alex. Sinclair, when taking the chair at the last meeting of the Swansea Corporation Electric Lighting Committee. Ald. Daniel Jones said that not only the chairman, but the department could be congratulated, because the Colonel's son, before joining the Army, was employed at the Corporation electricity station. He moved that congratulations be recorded on the minutes. The resolution was carried unanimously.

Will.—The late Sir WM. RAMSAY, F.R.S., left £17,896 personal estate.

NEW COMPANIES REGISTERED.

Bury Electrical Plant Co., Ltd. (145,680).—Private company. This company was registered on January 2nd, with a capital of £3,000 in £1 shares, to carry on the business of electrical engineers and contractors, suppliers of electricity, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic, and other apparatus, &c., and to enter into an agreement with O. Ashworth, G. K. Haworth, and W. A. Bale. The subscribers (each with one share) are: O. Ashworth, "Ona," Holcombe Road, Green Mount, near Bury, merchant; G. K. Haworth, "Strathmore," Bury New Road, Ramsbottom, merchant; W. A. Bale, 607, Rochdale Old Road, Bury, incorporated accountant. The first directors (to number not less than two or more than three) are: O. Ashworth and G. K. Haworth. Qualification, 50 shares. Solicitor: G. Clough, 8, Garden Street, Bury. Registered office: Castle Grounds, Bury, Lancs.

Ercole Marelli & Co., Ltd. (145,688).—Private company. This company was registered on January 3rd, with a capital of £20,000 in £1 shares (preferred), to carry on the business of makers and importers of and dealers in electric and ventilating fans of all kinds, electric dynamos and alternators, direct and alternating-current motors, and dynamos for galvoplastic industries, &c., and to enter into an agreement with E. Marelli. The subscribers (each with one share) are: A. M. Baroni, 19-20, Garlick Hill, E.C., electrical engineer; F. J. Manning, St. Michael's House, Basinghall Street, E.C., solicitor. The first directors (to number not less than two or more than five) are: E. Marelli, A. S. Benni, and A. M. Baroni. Qualification, £5. Remuneration, as fixed by the company. Solicitors: Jones, Hall & Manning, St. Michael's House, Basinghall Street, E.C. Registered office: 19-20, Garlick Hill, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Coatbridge & Airdrie Electricity Supply Co., Ltd.—Further charge on the company's undertaking and property, present and future, including uncalled capital and Coatbridge and Airdrie undertakings, and benefit of certain agreements, contracts, &c., dated December 21st, 1916, supplemental to charge dated October 17th, 1906, to secure £3,000. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, Moorgate Place, E.C.

Tyne Electric Steel Foundries, Ltd.—Particulars of £30,000 debentures created December 8th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £15,300. Property, charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Telephone Co. of Egypt, Ltd.—A memorandum of satisfaction to the extent of £500 on December 20th, 1916, of debenture stock covered by trust deed dated July 27th, 1904, and three supplemental deeds of acknowledgment dated February 21st, 1906, March 4th, 1908, and October 27th, 1907, securing £200,000, has been filed.

Henry White & Co., Ltd.—A memorandum of satisfaction to the extent of £900 on June 3rd, 1915, £1,100 on August 31st, and £8,000 on December 4th, 1916, of debentures dated December 11th, 1903, securing £10,000, has been filed.

City of Oxford Electric Tramways, Ltd.—A memorandum of satisfaction to the extent of £1,100 on December 15th, 1916, of charge dated 1st, 1916. All shares taken up; 15s. per share called up on 8,500 "B"—

Brown, Boveri & Co., Ltd. (89,167).—Capital, £50,000 in 1,500 "A" and 8,500 "B" shares of £10 each. Return dated December 1st, 1916. All shares taken up; 15s. per share called up on 8,500 "B"; £6,375 paid; £7,500 considered as paid on 1,500 "A." Mortgages and charges: Nil.

Pirelli, Ltd. (103,068).—Capital, £8,000 in £5 shares. Return dated October 26th, 1916. All shares taken up. £8,000 paid. Mortgages and charges: Nil.

CITY NOTES.

Dublin United (Electric) Tramways, Ltd.

The directors recommend a dividend of 6 per cent. per annum (less tax) on the preference, and final dividend of 5 per cent. (less tax) on the ordinary shares, both for the half-year ended on December 31st, 1916, being the same rate as at the same period in 1915. Towards rail renewal £20,000 is set aside, and towards reserve and renewal fund £7,000, and the carry-forward amounts to £13,359. At the corresponding period in 1916 the respective amounts were: £18,000, £5,000, and £18,045. During 1916 the passengers carried were 60,448,121, and the receipts were £319,612, as compared with 60,165,648 passengers carried, and receipts £317,762, in 1915, an increase of 282,473 passengers and of £1,850 in receipts. Ald. Cotton, M.P., has resigned his directorship owing to infirm health; the board have co-opted Mr. W. Hewat.

Isle of Thanet Electric Tramways & Lighting Co., Ltd.

Mr. A. R. MONKS, presiding at the annual meeting recently, moved the adoption of the report, which showed for the year ended September 30th last a profit of £9,742, compared with £10,050 for the previous year. The Isle of Thanet had passed through another year of severe depression. Since the end of the financial year the tramway receipts had shown some increase, but substantial improvement could not be expected until the termination of the war. Mr. Monks said that this was, perhaps, the worst year they had ever had. In addition to the common causes operating in war-time against tramways on the East Coast, they had had Bank Holidays, aircraft raids, and sunless times. They had had difficulty in maintaining their staff; their women conductors had been quite satisfactory. The revenue account showed a decrease in traction of £2,976, and in sale of electricity £924, although from October, 1915, they had charged an extra 10 per cent. on electricity sales. They took advantage of the high price of scrap copper and rails to realise those stores. The total revenue was £28,835, a decrease of £2,752. In the pre-war year of 1913 the figures were £19,670 better than those of 1916. The increased power station costs (£797) this

year arose from the price of coal and coke. Coke had risen very seriously (£450), so that they had had to use more coal than if they could have had ample supplies of coke. They were using Kent coal in combination with Welsh coal, and although at first it was not quite satisfactory, during the last few weeks it had been so. They had entered into no contract for coal for the current year, but they had no anxiety about it, as they had fair stocks and a fair amount coming from running contracts. The total operating expenses were £19,092, a saving of £2,445 for the year. Really, the position was better than appeared on the face of the accounts, having regard to the increase in wages and the increased cost of material. Until the war was over they must go on marking time and preserving the concern as well as they could.

German Electrical Companies.

The Karbidwerk Lechbruck, A.G., after making provision for depreciation, reports net profits of £2,200 for 1915-16, as in the preceding year. A dividend of 4 per cent. is in contemplation on a share capital of £55,000, being the same rate as in 1914-15.

The E. H. Geist Elektrizitats, A.G., of Cologne-Zollstock, which went into voluntary liquidation a few years ago owing to the pressure of competition on the part of the large firms, has closed the year 1915-16 with an unchanged deficit of £24,000, which prevailed at the beginning of the winding-up proceedings.

The directors of the *C. J. Vogel (Telephon-Drahtfabrik), A.G., of Berlin-Adlerhof*, report net profits amounting to £57,000 for 1915-16, as compared with £48,000 in the previous year. It is intended to pay a dividend at the rate of 16 per cent. on the old share capital of £175,000, as compared with 15 per cent. in 1914-15, and 8 per cent. on the new shares.

The report of *Siemens Elektrische Betriebe, A.G., of Berlin*, which refers to the year ended on September 30th, 1916, states that the value of the connections of the electricity works owned by the company, and of those in which it is otherwise interested, increased by 25 per cent., the production in KW.-hours was 30 per cent. higher, and the receipts 20 per cent. greater, but the final results showed no improvement, owing to the enhanced cost of materials and labour. After placing £28,000 to depreciation, as in 1914-15, the accounts indicate net profits of £83,900, as compared with £83,200 in the previous year. It is proposed to pay a dividend of 5 per cent. on the ordinary share capital of £1,500,000, as against 5 per cent. in 1914-15, and 6¼ per cent. in 1913-14. The loan capital amounts to £1,626,000, and recourse has been had to the banks for additional credit, which has increased from £146,000 in 1914-15 to £470,000 now, for the purpose of extending existing supply works.

The Elektrizitats A.G. vorm. Schuckert & Co., of Nuremburg, is one of the two proprietors of the Siemens-Schuckert Works, and the company's financial results for the year ended on July 31st, 1916, were given in a recent issue. According to the directors' report, the proceeds derived from the inland investments were not considerably less than those in the preceding year, but the foreign holdings experienced material changes. For instance, the whole of the shares in the Aktieselskabet Hafslund, of Vinderen, near Christiania, were sold to a Norwegian group, a special incentive being given by the high position of the Norwegian rate of exchange. It was also possible for the company favourably to dispose of all its Italian investments, and thus become relieved of the considerable risk incidental to holdings in hostile countries, and the large amount of money thereby realised equipped the company for new business. In the case of the remainder of the investments in hostile countries and in the war zone, adequate provision had been made for depreciation, which would exclude any loss in future years.

The directors of *Siemens & Halske, A.G., of Berlin*, report that most of the company's departments were preponderatingly occupied on war work in 1915-16, further displacements having taken place in the direction of increased transformation of working, new plant, restrictions, and extensions. In particular, a great demand was made on the branches for signalling and control, conductors, wireless telegraphy, telephony, internal-combustion engines, and carbon electrodes for various purposes. Much technical work had to be overcom in consequence of the numerous new requirements put forward, and considerable progress and success were achieved; and great activity was also exercised for the needs of the Army and Navy outside of the company's regular departments. The total production was not less than in 1914-15, the financial results, despite the displacements in some departments, approximating to those in the preceding year. As previously reported, the dividend is at the rate of 12 per cent., as in 1914-15. The "permanent investments" are valued at £4,168,000, as against £4,426,000, and include interests in the Siemens-Schuckert Works, the Austrian Siemens-Schuckert Works, Siemens Bros. & Co., Ltd., the Russian Siemens and Halske Co., and the Russian Siemens-Schuckert Co.

The Siemens-Schuckert Werke, G.m.b.H., of Berlin, whose dividend of 10 per cent. for 1915-16 was recently announced, reports that the company's output of peace manufactures was influenced by Government measures and the further withdrawal of workmen for the Army. A considerable share was taken in the manufacture of substitutes, particularly for conductors and their insulation, which had met the requirements, although much time had been needed to gain the confidence of consumers in the use of the substitutes. It was, however, impossible fully to cope with the growing demand. The export trade to trans-marine countries and to Spain entirely ceased, but a market existed in other countries. As a result of the great requirements of the home chemical industry, and the iron and steel and engineering industries, the company received large orders for generating plant in the form of units up to 60,000 KW. for generators and transformers in connection with transmission pressures up to 100,000 volts. The report adds that the transfer from war to peace manufactures would make a large demand on the liquid funds, which showed a further increase as compared with 1914-15. The subscriptions made by the company and its officials to the five German war loans, together with the contributions of the two proprietary companies, are reported to have reached £2,800,000.

Fellows Magneto Co., Ltd.—The "Financial Times" states that the subscription list has been closed, preferred shares to the value of over £46,000 out of the 50,000 8 per cent. cumulative preferred and participating shares offered having been subscribed for, and allotted.

Northampton Electric Light & Power Co., Ltd.—An issue of 50,000 "B" shares of £1 each is offered for subscription at par, preference in allotment being given to the existing share and debenture holders. The issue will be made as ordinary shares unless the applicant elects to take 5 per cent. cumulative preference shares, the two classes ranking *pari passu* with the existing shares of the corresponding classes.—*Financial Times.*

Anglo-American Telegraph Co., Ltd.—Balance dividend of £1 10s. per cent. upon the ordinary consolidated stock for the year 1916, less income-tax at 4s. 9d. in the £; balance dividend of £1 10s. per cent. upon the preferred stock for the year 1916, less income-tax at 5s. in the £; first and final dividend of £1 10s. per cent. upon the deferred stock for the year 1916, less income-tax at 4s. 6d. in the £. The above dividends, together with those already paid, will amount to £3 15s. per cent. on the ordinary consolidated stock, £6 per cent. on the preferred stock, and £1 10s. per cent. on the deferred stock for the year.

India.—The Poona Electric Supply Co., Ltd., has been incorporated under the Indian Companies Act with a capital of Rs. 10,00,000, divided into 6,000 ordinary shares of Rs. 100 each and 4,000 preference shares of Rs. 100 each.

Messrs. Cromptons, Bombay, Ltd., have applied to the Government of Bombay for a licence for the electrification of portions of the Poona City, Poona Cantonment, Kirkee, the Poona Suburban Area, &c., and an agreement has been entered into between them and Messrs. H. M. Mehta and H. M. Watson on behalf of this company for the purchase of the licence. The company will generate, develop, and accumulate electrical power, and, in general, carry on the business of electricians in all its branches. The managing agents are Messrs. H. M. Watson & Co., of Apollo Street, Bombay.—*Indian Textile Journal.*

Stock Exchange Notice.—Application has been made to the Committee to allow the following to be quoted in the Official List:—

Southern Brazil Electric Co., Ltd.—£507,000 6 per cent. mortgage debentures, Nos. A1 to 850 (£500), B1 to 1,000 (£100), C1 to 500 (£50), and D1 to 1,000 (£20).

Kaministiquia Power Co.—Dividend of $1¾ per share, or at the rate of 7 per cent. per annum, for the quarter ending January 31st.

Direct United States Cable Co., Ltd.—Interim dividend of 2s. per share, less income-tax at 5s. in the £, being at the rate of 4 per cent. per annum for the quarter ended December 31st.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the five weeks ended December 1st, 1916, amounted to 2,366,060, compared with 2,093,887 units in the corresponding five weeks of 1915.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange business has been contracted in most directions in consequence of the coming this week of the War Loan prospectus. It is officially announced that the loan will be out on Thursday night, and that prospectuses will be available for distribution by nine o'clock on Friday morning. So far, there has not been much selling of existing securities, and that there is an eager welcome awaiting the new loan is beyond a doubt.

No surprise would be expressed had there been some sort of a rush to sell stocks and shares, with a view to providing money for investing in the new issue, but probably it is better appreciated now than it was at the time that the 4½ per cent. War Loan appeared that for sellers to be able to realise, there must also be buyers, and that these latter may themselves be potential applicants for the new loan if they are not called upon to take the older securities.

So far as electric lighting shares are concerned, prices are much the same as they were a week ago. As we were then saying, a little interest attaches to the forthcoming dividend announcements, which are expected to be about the same as those of last year in companies serving the City; while, as regards the West End undertakings, it is possible that in some cases we may see a decline.

The Board of Referees sitting to hear excess profits tax appeals have given their decision, as stated on page 8 of the last issue of the REVIEW, which is that in the case of the London-suburban and provincial companies the statutory percentage should be increased from 6 per cent. to 7½ per cent., and that in the case of the London companies the percentage should be raised from 6 to 7 per cent.

The Home Railway market has shown a fair degree of buoyancy, considering the fact that business has once more fallen away to something like a minimum. Strength is noticeable mostly in stocks of the lower-priced order. Districts are something of a favourite at 17½, a rise of 1½. London Electric ordinary shares rose 7s. 6d. to 2⅝, and Underground Electric "A" shares gained a few pence at 6s. 9d.; the £10 shares hardened to 2¼, while the company's income bonds, after touching 94¼, reacted to 93¾. Metropolitan and Metropolitan Surplus Land stocks are firm at 25 and 48 respectively. North London ordinary stock fell 3 points to 70, apparently on pressure to sell on behalf of a deceased account. The Central London group is steady.

The market is strongly convinced that the raising of fares on the lines other than the Tube railways will have a marked effect upon the traffic of the latter, and already we have heard not a little as to the money which is to be saved by going on certain routes by omnibus instead of by train, though at the expense, it may be, of a certain amount of time. The pre-ordinary stocks are holding their prices firmly, and once more it is more difficult to buy than it is to sell in not a few instances.

The declaration of a dividend of 30s. per cent. for the year on the deferred stock of the Anglo-American Telegraph Co. goes against 33s. 6d. paid a year ago. The market, however, was prepared for this, because the extra 3s. 6d. last year was in the nature of an interest payment upon interest, and was not considered likely to be repeated. There was a little activity in advance of the declaration—sufficient to wing memory with recollection of the days when Anglo "A" used to be one of the chief gambling stocks in the markets, its annual dividend being awaited by thousands of keenly-interested speculators. To-day it has descended—or ascended— to the level of a sober speculative investment, in which a movement of 10s. per cent. causes as much surprise as in the old days four times that amount would have done.

The Eastern group generally is firm; and there has been a little buying of Western Telegraph shares, probably on behalf of those who are selling their West Coast of America shares to the Western Co. on the terms indicated here last week. Marconis are stagnant, and therefore inclined to be dullish. Some of the Irish holders have recently turned sellers, and the price has drooped to 55s. Americans are what the market calls sticky about 16s. Canadians remain unchanged at 9s. 3d.

Affairs in Brazil are considered to wear a much more promising aspect than they did two or three weeks ago. Active buying of the country's bonds and railroad shares has aroused renewed attention in the industrials. Curiously enough, however, Brazilian Tractions, after reaching 52, gave way to 50½, it being said in this case that the holding of a well-known proprietor, recently deceased, may have to be marketed, though, on the face of it, this seems to be improbable.

Mexican matters also are declared to be on the mend, although, as the news comes from Washington and New York, too much importance need not perhaps be attached to it. However that may be, the prices of Mexican Railway issues are certainly better; and should the optimism continue, no doubt it will soon find its way to the Mexican industrials, which are, at present, more depressed than ever. Mexico Tramways bonds are particularly flat.

Anglo-Argentine Tramways lean to the duller side. British Columbia Electric stocks have pursued their improvement, the preferred and the deferred both attracting purchasers, from which the inference is drawn that the unfortunate result of the company's last year's working may be regarded, as we suggested at the time, as the low ebb to which its fortunes are likely to decline. Two or three of the debenture stocks in this group are rather better. Amongst Latin-Canadians the tendency is steady, without noticeable features developing.

British Aluminium ordinary continue heavy at 28s. 6d., and Electric Constructions went back to 20s. India-Rubber are ¼ down at 12½. Castner-Kellners weakened to 3 5/16. Taken all round, the industrial market is unusually quiet, for which, naturally, the imminence of the War Loan is declared to be the principal cause. Another consideration, not quite so prominent, is the uncertainty felt in regard not only to present excess profits duty, but to the possibility of the existing rate being increased.

This factor bulks largely in the quietude prevailing amongst rubber shares, which is in striking contrast to the buoyancy displayed twelve months back, when something like a boomlet was in progress. It manifests itself also in the iron, coal, and steel group, where the recent peace talk has had the effect of causing people to ask what is likely to happen in this particular industry after the war is over, and war profits are replaced by more normal earnings. The whole of the Stock Exchange, however, waits upon the coming of the War Loan, the influence of which is likely to be felt for the greater part of the time during which the subscription lists are open.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Jan. 9, 1917.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3⅝	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	3 7/8	—	6 11 0
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11½	— ⅛	7 2 3
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 18 3
do. 6 per cent. Pref.	6	6	9⅛	—	6 1 6
Kensington Ordinary	9	7	5⅝	—	6 4 5
London Electric	4	3	1⅛	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4 7/8	—	6 15 4
Metropolitan	3¾	3	2½	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref.	7	7	1 4/8	—	6 7 8
Westminster Ordinary	9	7	5⅛	—	6 4 5
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	95	—1	6 6 4
do. Def.	80/-	83/6	93½	—	6 6 4
Chile Telephone	8	8	7⅝	—	5 12 8
Cuba Sub. Ord.	5	5	8½	—	6 8 6
Eastern Extension	7	8	14	—	*5 14 4
Eastern Tel. Ord.	7	8	140½	—	*5 14 0
Globe Tel. and T. Ord.	6	7	12½	—	*5 12 0
do. Pref.	6	6	10	—	5 18 5
Great Northern Tel.	22	22	87	+1	5 19 0
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	2⅝	— ⅛	3 12 9
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2½	— 1/16	4 9 0
United R. Plate Tel.	8	8	64⅛	—	*5 19 8
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅞	—	*5 15 4
HOME RAILS.					
Central London, Ord. Assented	4	4	65½	—	6 2 2
Metropolitan	1½	1	25	—	4 0
do. District	Nil	Nil	17	+1½	Ni
Underground Electric Ordinary	Nil	Nil	2½	+ 1/16	Nil
do. do. "A"	Nil	Nil	6,9	+3d.	Nil
do. do. Income	6	6	93½	+ ⅛	*6 8
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅛	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	3	—	9 3 4
do. 2nd Pref.	5½	5½	2⅞	—	—
do. 5 Deb.	5	5	64½	+2	7 15 0
Brazil Tractions	4	4	50½	—1½	7 18 5
Bombay Electric Pref.	6	6	10½	—	5 17 3
British Columbia Elec. Ry. Pfce.	5	5	64½	+1	7 17 6
do. do. Preferred	—	Nil	42½	+2	Nil
do. do. Deferred	—	Nil	40½	+3	Nil
do. do. Deb.	4½	4½	62½	+ ⅛	6 16 0
Mexico Trams 5 per cent. Bonds	—	Nil	30	—2½	Nil
do. 6 per cent. Bonds	—	Nil	22½	—5	Nil
Mexican Light Common	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	15½	—	Nil
do. 1st Bonds	Nil	Nil	27½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	21⅞	—	5 6 9
British Aluminium Ord.	5	7	28⅝	—	5 12 3
British Insulated Ord.	15	17½	11½	—	7 5 10
British Westinghouse Pref.	7½	7½	2⅜	—	6 6 4
Callenders	15	20	13	—	7 9 10
do. 5 Pref.	5	5	4½	—	5 11 8
Castner-Kellner	20	22	3 3/16	— 5/16	6 12 7
Edison & Swan, £8 paid	Nil	—	7/16	—	Nil
do. do. fully paid	Nil	—	1⅛	—	Nil
do. do. 4 per cent. Deb.	5	5	61½	—	8 2 8
Electric Construction	6	7½	1	— 1/16	7 10 0
Gen. Elec. Pref.	6	6	9⅜	—	6 3 1
do. Ord.	10	10	13½	—	7 5 6
Henley	20	25	16	—	7 13 10
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	— ¼	*8 0 0
Telegraph Con.	20	20	83	—	*6 5 0

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	
		£	£		£	£		Inc.
Bristol (Trams)	Dec. 29	17,977	—4,180	52	258,696	+ 5,247	30·5	..
Cork	,, 31	2,118	+ 167	52	26,685	+ 680	9·89	..
Dublin	,, 22	24,645	+ 603	51	311,281	+ 2,197	54·56	..
Hastings	,, 31	3,959	+ 647	52	64,070	+ 4,007	19·3	..
Lancashire United	,, 27	6,620	+ 268	52	94,776	+ 5,468	42	..
Llandudno-Col. Bay	,, 29	822	+ 55	4½	822	+ 55	6·6	..
Tyneside	..	..	..	..	..	..	..	..
Anglo-Argentine	,, 31	317,974	+6,487	52	2,672,403	+ 4,677	..	..
Auckland	,, 15	21,682	— 122	28	126,697	+ 854	26·69	..
Calcutta	,, 29	19,370	+1,490	..	..	+13,358	..	..
Kalgoorlie, W.A.	October	2,716	..	43	23,983	..	20.5	..
Madras	Dec. 31	4,491	+ 705	52	51,858	+ 3,926	..	..
Montevideo	Dec.	31,364	+ 69	9	69,738	+ 56	..	..
Dublin-Lucan Rly.	Dec. 31	551	+ 71	26	4,251	+ 383	7	..

COLONIAL TELEGRAPHS AND TELEPHONES.

BY R. W. WEIGHTMAN, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

(*Continued from page* 27.)

LINE WIRE.

IN the Crown Colonies and South Africa galvanised iron wire is not so much used now, although for minor telegraph circuits 200-lb. and 400-lb. wires are still employed considerably; 200-lb. wire is also used to some extent for unimportant telephone circuits.

For long-distance telegraph lines 150-lb. and 200-lb. copper wires are used. Practically all telephone circuits are of copper. In South Africa 70-lb., 100-lb., 150-lb., 200-lb., 300-lb., and 400-lb. gauges are used according to the grade of service required.

The 70-lb. wire is used for local distribution on telephone exchange systems, and for this service it is, in the author's opinion, a useful and adequate wire.

Bronze wire, usually 150 lb. per mile, is employed in some Colonies for long spans, but not largely, and copper-clad steel wire has also been used to a slight extent. In two Colonies where this latter wire has been tried it has quickly broken down owing to moisture penetrating the copper, probably through defects caused in the handling, and causing corrosion of the steel core. Where it is erected near the sea the thin coating of copper is soon eaten away, and the life of the wire is very short indeed.

In situations where the insulation of open wires may be lowered from any cause, hard-drawn copper and bronze wire, with a special insulation to a Post Office specification, is sometimes used. This insulation consists of impregnated paper, cotton lapped and braided, the braiding being impregnated with a weatherproof composition, the basis of which is red lead. This compound is impervious to moisture, and its waterproof properties appear to improve with exposure to the air.

The Britannia joint is commonly used for jointing both iron and copper wires, but here and there McIntyre sleeves of both oval and twin-tube type have been introduced. The author has all along favoured the wire joint, as with native workmen there is less risk with it. In inexpert hands the sleeve is liable to be badly twisted and the wire damaged. On the other hand, with the sleeve the soldering iron is dispensed with, and this is certainly a great advantage in a country where the work is in skilled hands.

The practice as to terminating line wires varies. That favoured by the author was to terminate, on both sides of a road or railway crossing, at acute angle poles; also every half-mile on heavy routes, and every mile on light routes, all terminating points being securely stayed.

Earth plates of both galvanised iron and copper are used. The former costs about half the latter, and serves the purpose equally well. Care should be taken to have plates of the same material at both ends of the wire. In Canada galvanised iron rods, which are driven well into the ground, are largely used.

Canada.—Copper and iron wire are both used largely on both telegraph and telephone systems. The open telephone circuits in Canada are transposed. Phantom telephone circuits superimposed on physical circuits are largely used, and special transpositions are arranged in these cases. McIntyre sleeves are employed generally for making joints.

As a rule the line wires are bound to the insulators by a length of wire of the same gauge as the line wire. It is taken round the neck of the cup, one end is passed over and the other under the line wire, and each end is given five complete long tight wraps around the line wire.

There are a few farmers' lines on fences in Canada. The fences generally consist of three separate strands of barbed wire on wood posts, the top strand being 15 to 20 in. from the next. The top wire is used for the line, and it is not usually insulated in any way, but merely stapled to the posts. The earth is used for the return. In dry weather no great amount of leakage takes place, owing to the extreme dryness of the atmosphere, and fairly satisfactory talking is possible over short distances; but in wet weather the speech-transmission value of such lines is very poor. In a few instances the line wire is insulated on porcelain knobs. At creeks and road crossings the line wire is raised on poles. These lines are not permitted to be joined up to public exchanges.

Australia.—For main trunk telephone circuits copper wire 300 and 400 lb. per mile, and for minor trunk circuits which connect with the main trunk system, 100 and 200 lb. per mile, is used. For other minor trunk lines, and also for telegraph circuits, other than those on which fast-speed Wheatstone is employed, 200 and 400-lb. galvanised iron wire is used. For the high-speed circuits copper wire is provided. Galvanised iron wire suffers very little from corrosion, except when erected on the sea coast.

TELEGRAPH SYSTEMS.

In the Crown Colonies, Post Office standard apparatus is in general use, and the circuits are to Post Office diagrams. The Cardew vibrator is used a good deal, in some cases superimposed on Morse lines, and also in place of the Morse on lines that suffer chronically from low insulation.

The Vyle polarised sounder is replacing the sounder and relay, and as also being adopted with condensers on central-battery omnibus circuits. The standard practice on these circuits is to use a voltage of 80 with a feed resistance, non-inductive, of 1,000 ohms between the battery and the line. The sounders are wound to 2,000 ohms, and the condenser is of 4 mfd. capacity. On a line of 150-lb. copper, 120 miles in length, the author found working was improved by introducing sufficient non-inductive resistance into the line tapping at each station to make the resistances of the tappings at all stations uniform. Where primary cells are used, the practice is to use a 2,000-ohms feed resistance.

At Colombo, Ceylon, the Baudot system has been installed on a circuit 800 miles in length, connecting with Madras. There is usually one repeater in the circuit, but direct working is often carried on satisfactorily. The apparatus is similar to that used by the Indian Government, and differs essentially from Post Office practice in that the distributors as well as receivers are motor-driven. Some difficulty was experienced at the start owing to the storage batteries, which were already in use for other telegraph purposes, being of very low capacity, viz., 18 ampere-hours. The trouble was overcome by the motor circuits being tapped off different sections of the battery, so that only one motor was run off the one lot of cells. With this arrangement there was no further trouble.

The system was introduced to fit in with standard practice in India. The native Morse operators quickly picked up the new alphabet, and became expert in manipulating the instruments. The double set installed in the first place was soon afterwards duplexed satisfactorily. This experience should be of value to other administrations whose traffic is on the increase. The Morse is undoubtedly better suited to native operators than the more delicately constructed type-printing apparatus, and it will continue to hold its own on ordinary lines, and even on lines on which the traffic is sufficient to require a Morse duplex to carry it. But for heavier traffic one or other of the type-printing multiplex systems, of which there are several now on the market, will be found to give better results than either the Morse quadruplex or the Wheatstone.

The question at what stage secondary cells should be installed for telegraph working should not be decided by the mere financial saving that may result. The equipment is not costly, the constancy of the voltages makes for good working, and there are no complaints of weak signals, unavoidably common with primary cells; these are advantages which cannot be measured in £. *s. d.* Where the number of primary cells in use is over 200, and a local supply of current is available for charging, the adoption of this system is worth considering.

Leclanché porous-pot form cells are much used on ordinary line and local circuits. The Leclanché is still erroneously regarded by many as suitable only for light intermittent work, and the prejudice against it for heavy work dies hard.

In South Africa, Post Office standard apparatus is also in general use. Single needles with tapper keys are used on omnibus circuits connecting with railway stations in the Natal Province. For this class of circuit they are probably more suitable than any other type of instrument. They require no adjustment, and respond to signals of varying strength within wide limits. In the larger offices the double-plate sounder takes the place of the single needle. The Vyle polarised sounder is replacing the relay and sounder, and it is also being adopted on central-battery omnibus circuits, and on concentrator systems. The author regards this system as one of the greatest developments in telegraphy in recent years. It has the centralised battery feature of the closed circuit system without the waste of current that takes place with the latter, while under the charge and discharge process of operation it has the positive action of a double-current system. There should be a large field for the application of this system on the many unimportant omnibus circuits that run out from centres in the Dominions and Colonies.

One of the longest quadruplex lines is that between Durban and Johannesburg, about 350 miles by line, and this works quite satisfactory without a repeater.

The Wheatstone automatic has been in use between the main centres for many years, and the Creed apparatus has been introduced more recently. The Creed circuits are worked duplex, and high-speed duplex repeaters are employed on them where necessary. One of the longest of these circuits is that between Cape Town and Johannesburg, about 1,000 miles, and this has two repeaters on it. The latest type of sounder silencer, that recently brought out by the Automatic Telephone Co., on the principle suggested by Major A. C. Booth, of the British Post Office, is being installed. Motor-driven transmitters have been introduced. Both Gell and Kotyra keyboard perforators as well as ordinary mechanical perforators are in use.

At the principal offices the working current is got from secondary cells with charging and distribution equipment of Post Office standard design. At other stations primary cells of both bichromate and Leclanché types are used. The principle of using Leclanché cells for all purposes up to the point where storage cells can be installed, adopted by the British Post Office after the searching investigations of Mr. Lucas, is being applied as circumstances permit. These investigations proved the great suitability for heavy work of the

porous-pot type of cell when charged with a finely granulated form of depolarising mixture; it is, besides, the cleanest and easiest cell to handle, and there is no waste of material when the cell is in disuse. The "sack" form of Leclanché cell is even more suitable than the porous-pot form where heavy currents are required, owing to its lower internal resistance. Its initial cost as compared with the porous pot is, however, against it. Dry cells are only used on telegraph work where portability is desired.

In Canadian practice minor circuits are worked single current on the closed-circuit system. The apparatus generally is of American make, and the circuits of American design.

On many of the longer telegraph circuits, repeaters are employed. The longest line is on the Canadian Pacific system, from Montreal to Vancouver (2,900 miles), duplex, with two repeaters.

Where power is available from two different supply stations, the Canadian Pacific Co. employs motor-generators directly on the line and local circuits. Two separate machines are provided for each voltage, one with the positive and the other with the negative earthed, and in each case a stand-by machine is installed, to replace either of the two machines in the event of breakdown. This means for main-line current a separate set of three machines for, say, 125 volts, another set for 200 volts, and for the longest circuits another set for 400 volts. For local circuits machines giving 25 volts are used, and resistance is inserted where necessary to make all local circuits uniform. Where power is available from one supply station only, secondary cells are used. Both negative and positive batteries are installed, and stand-by batteries of 50 per cent. the value of the batteries in use are provided. The voltages employed are notably high compared with British practice. Enamelled-coil windings are largely used, with satisfactory results so far.

In Australia telephones are now frequently used where formerly Morse apparatus would have been installed. The introduction of either the Murray or Western Electric multiplex or the Baudot system is under consideration. Creed apparatus was introduced between the Eastern and Western States in 1913, and has been in regular use for the past two years.

A reorganisation of the circulation of traffic from small offices has recently been made. Where formerly a number of small offices situated at great distances from the chief office of a State, worked direct with the chief office on one wire, they are now sub-divided and connected on short lines with distributing centres which have fast direct communication with the chief office. This involves an extra transmission, but the experience is that the traffic is handled more rapidly and congestion is reduced to a minimum.

In New Zealand the Murray multiplex is being introduced with two quadruple sets at Wellington, which will connect with a similar set at Auckland, and another at Christchurch. It is considered that this system will solve the traffic problems of the Dominion better than any of the other type-printing systems.

The longest telegraph circuit is that between Wellington and Dunedin, about 530 miles, including a section of submarine cable 40 miles in length. The telephone is largely used for the transmission of telegrams, and by its use the most remote places are brought into touch with the general system of the country.

Telephone Systems.

Throughout the Crown Colonies, and also in South Africa, the natives, who form the large majority of the inhabitants, are not sufficiently educated, or concerned in commercial pursuits, either to appreciate the value of the telephone or to use it.

At Suva, Fiji, a multiple magneto board on the "ring through" system is about to be installed. This will have an ultimate capacity of 1,200.

The author is aware that there are objections to the adoption of this system in a large exchange, but he is of opinion that for exchanges in countries where the commercial conditions are not so pressing as in large centres, the "ring through" has its advantages. A subscriber does not perhaps provide a special attendant for his telephone, and if he is busy when his bell rings he may not be able to answer immediately. With the "ring through" system, the calling subscriber does the ringing, and if prompt attention is not given, a second, and further rings can be given without disturbing the operator, and the calling subscriber knows that his inability to get through is not due to any remissness of the operator, but to inattention at the called subscriber's end. When the conversation is finished, both subscribers depress their "ring off" buttons. This method of clearing is also criticised, but from years of experience of "ring through" exchanges, the author can say that while one subscriber may forget to "ring off," it very rarely indeed happens that both forget, and the pressing of either button operates the clearing signal.

There are no automatic exchanges in any of the Crown Colonies. Not only are insulation difficulties felt to be a bar to their introduction in the damp climates of these countries, but the need for the employment of highly skilled mechanicians to look after the plant is regarded as another obstacle.

The distribution at the larger of these exchanges is generally by means of cables from the exchange led to pole lines through distribution and protector boxes fixed to the poles; 10-lb. and 20-lb. conductors are employed.

The underground cable distribution is sometimes arranged by means of cast-iron boxes of Post Office types in the manholes, but the method most generally employed now is that of lead branching joints.

Where the distribution is by means of armoured cable the lead-sleeve joints are usually in cast-iron boxes for protection and to preserve the continuity of the armouring. Where aerial lead-covered dry-core cable is used it is supported in the usual way on steel suspender wires. A cable suspender best suited for a tropical climate is made with a loop of three-ply tarred marline, which is attached to the suspender wire by a suitable galvanised steel hook. Raw-hide suspenders quickly deteriorate in a hot, damp climate, and zinc suspenders are too rigid for the lead sheathing of the cable; they are apt to grip the cable too tightly and set up crystallisation and fracture of the lead. A free means of suspension is essential.

For small exchanges the author prefers the underground armoured cable. It can be used with complete safety. The upkeep is practically nil; all the work of erecting suspender wires and the heavy stresses they bring upon the poles are obviated.

The termination of cables in a building usually follows Post Office practice, the cables being connected to distribution cases by means of a link of enamel and cotton-covered lead-sheathed cable made airtight with beeswax. This class of cable is also used between the underground cables and the main frames in exchanges. Similar cable, but without the beeswax seal, of single or multiple pairs is used between the distribution cases and instruments. This cable is most useful in any position in which a short cable lead is wanted, as in running wires into a small office or testing station. Its insulation can be relied upon, and the careful sealing necessary with dry-core cable is obviated.

Aerial rubber cable has been tried in some of the tropical Colonies, but it is liable to break down owing to the heat and rain to which it is exposed.

Where underground cables are connected to pole lines it is usual to take out not more than 25 pairs at any distribution point. This permits of comparatively light and inexpensive pole-line construction.

Special measures are taken in the manufacture of all apparatus for use in the hot humid climate of the tropical Colonies to keep up the insulation of all electrical parts. Teak-wood is always used, and screws are of non-corrodible material. Iron and steel mounts are zinc plated, and precautions are taken as far as possible to prevent insects getting inside instruments. For coil windings of large gauge, plain enamelled wire is the rule, but it is sometimes given a single lapping of silk which is impregnated with beeswax. The silk in this case is certainly a mechanical protection for the enamel, and is of value in this respect. Owing to the difficulty of properly enamelling wire of gauges smaller than about 30 S.W.G., small-gauge coil windings are given a single silk covering, and the coil is impregnated with a high-quality insulating varnish in a vacuum chamber. This impregnating process makes the coil quite moisture-proof.

All switchboard wiring and cabling is done with enamel and silk and cotton-covered wire.

In South Africa the number of telephones per 100 of the population, not including natives, is about three. The telephone services throughout the country are under the Government with the exception of the Durban exchange, which is owned and worked by the municipality. Every town and village of any importance has its exchange, and a large trunk system has been developed. At present the longest connections in regular use are about 500 miles in length. A speech efficiency equal to 30 miles of standard cable is aimed at, and intercommunication is given to all stations that come within this limit. Loading coils have not yet been introduced, but they will be employed when the time arrives to consider the longer trunk lines between the Cape and Transvaal main centres.

At the principal Government exchanges central-battery manual boards are in use, the largest being that at Johannesburg, with an ultimate capacity of 9,000 lines. At other towns magneto boards on the "ring through" system are employed; in others drop shutters are used, and, again, in other exchanges indicator-jack boards are in use with mechanically restoring clearing drops.

Magneto boards with automatic clearing are in use at certain exchanges. The hand micro-telephone is used throughout on subscribers' instruments.

Telegraph circuits are superimposed on telephone wires where it is advantageous to do so, and phantom telephone circuits are obtained wherever possible. The telephone is much used for public telegrams between outlying stations and central transmitting offices. On lines of this character it is not unusual for several offices to be in bridge on the same pair of wires, the calling being done by a code system of ringing. Magneto telephones are used, and silence cabinets of standard types are provided.

Both wet and dry cells are used on magneto telephones. The author always used wet cells in Natal, as he found them more reliable and economical than dry cells. A dry cell is no longer efficient when it becomes really dry, and in a hot, dry climate the moisture which keeps the cell active is liable

to evaporate quickly and leave the cell useless long before the elements are used up.

The underground cables and distribution methods vary in the different Provinces in accordance with the practice in vogue prior to the union, but the work of co-ordinating the methods to one standard has now made great headway. In present-day practice underground cables having 10-lb. conductors are in use. Heavier conductors are employed where required, also composite cables having large conductors for long-distance circuits. Lead branching joints in manholes are in general use on underground distribution. The joints are made solid with compound which is forced in under pressure.

Distribution is carried out both by underground direct cable, and on the block system from high poles by means of both dry-core cable and open wires. In both cases the internal distribution is through lead-covered cables to distribution frames or cases, and thence to the subscribers' sets.

(To be continued.)

REVIEWS.

The Electrical Contractor. By LOUIS W. MOXEY. London: Hill Publishing Co. Price 6s. 3d. net.

This book is written for the instruction of American electrical contractors, who, apparently, are as ignorant as those of England are reputed to be on the subject of conducting the business whereby they earn their living. On this side we are used to the statement that electrical contractors know nothing either of business methods or technical details. It is necessary for the enthusiastic supporter of municipal trading to find some justification for his views, and this is most easily done by proclaiming the incompetence of the contractor. It is, however, less easy to explain why American contractors should be so incapable as to make it necessary to write an elementary treatise such as Mr. Moxey has provided for their benefit.

The book is arranged in the reverse order to what one would naturally expect. It begins with profit recording and book-keeping; passes on to costing and estimating, and thence to mains calculations, finishing up with a chapter on illumination calculations and some rather elementary tables of "General Data." Most contractors would work out illumination details first, then calculate the cable sizes, work out the estimated cost, carry out the job—if they obtained the order—charge up the cost details, and after making up the books, return thanks for any profit left over.

Considering the book in what seems to be this more natural order, surely it cannot be necessary to write, for electrical contractors, separate chapters on simple illumination calculations, and on the calculation of voltage drop in A.C. and D.C. circuits, and to explain at length how to decide what size of conductor should be used.

If the book is written for electrical contractors such chapters should be unnecessary. If necessary to the reader, then that reader is not justified in claiming to be an electrical contractor; he should be reading an elementary text-book on physics at school.

Mr. Moxey's other chapters are more valuable, but, like many Americans, he seems inclined to let his system dominate his business. Probably in practice this is not the case, but his book reads as if all work has to conform to the system. The ordinary contractor naturally has a system, but he realises that many jobs will not fit into the system at all comfortably.

For example, Mr. Moxey gives a large number of tables covering the cost of various items of work, ranging from putting in engine foundations to fixing wire or tube. His cost tables are of some interest, but it is doubtful whether such tables would in practice be sufficiently useful to justify the labour in preparing them and keeping them up to date. Of course, a certain number of basic prices are essential to estimating, but conditions differ so widely between one job and another that the allowances necessary on this account almost destroy the value of the original figures. Mr. Moxey in effect recognises this. For example, in Table XXVII (Cost of Pole Line Construction) his figures for digging holes for 25-ft. poles range from 60 cents to 3 dollars, *i.e.*, in the ratio of 1 to 5. One may just as well estimate the cost from first principles (*i.e.*, common-sense and experience) as take such a tabulated result and decide whether the conditions correspond to the highest or the lowest figure.

Similar remarks might be made with regard to the system of costing by card records. They are of value, but in practice so many allowances and adjustments must be made that it is very difficult to reduce costs to exact basic rates. It must be done wherever possible, but to read Mr. Moxey's book gives one the impression that it is a very simple procedure, and this is far from being the case.

The book, of course, needs translation for English readers. Prices are all in dollars and cents; systems of wiring are in American (few English readers would understand exactly what is meant by "knob and tube work," for example), and labour costs are based on American rates, which are apparently about double those normally paid in London. There are also a few misprints and one or two errors, as, for example, the statement that the neutral conductor of a three-wire D.C. system should be *double* the size of the outers. Such items will doubtless be corrected in a later edition, and if this were then reduced to the basis of English rates and prices it would doubtless be of value to many contractors. At present it is to be feared that this would not be the case on this side of the Atlantic.

Electrical Engineering. First Course. By E. J. BERG and W. L. UPSON. London: Hill Publishing Co. Price 17s. net.

This book, emanating from two of the professors at Union College, Schenectady, is a somewhat difficult work to deal with. The authors, according to their preface, appear to have an objection to text-books as a general thing, but, for reasons set forth, they have decided to issue this one. The book is difficult to classify, inasmuch as it consists of such a heterogeneous collection of information. Some of the chapters are of the most elementary character, while others involve advanced mathematics, and would be far beyond any ordinary "first course" student.

The first three chapters discuss, on quite ordinary lines, units, form of work, and magnetism respectively. In Chapter IV, the integral calculus is freely used to establish the magnetic intensity at any point along the axis of a coil. Chapter V deals with the design of a cast-iron electromagnet to lift a weight of 1,000 lb. The subject and treatment appear to be altogether out of place at this stage. Chapters VI and VII treat of the generation of E.M.F. and inductance respectively. They are quite good, but a knowledge of the integral calculus and differential equations is requisite. Also, the section dealing with the generation of E.M.F.'s in non-uniform fields is so brief as to be scarcely clear. After this we have a very short but clear chapter on the properties of alternating currents. The characteristics and principles of direct-current generators are then dealt with.

Following is a very good chapter on the various constants used in the design of a continuous-current generator. The method adopted is to take the dimensions of an actual machine, and to analyse them exhaustively. A machine fitted with commutating poles then receives similar treatment. Next we have two chapters on D.C. generators in parallel and in series, and on electric motors. The treatment is quite elementary, and in no way remarkable.

Chapter XIV deals with the theory of the ballistic galvanometer. This chapter would be more in place in a text-book of physics than in the present treatise.

The next two chapters in this queerly-arranged book are very good, and deal with the vector representation of alternating waves and their application. The symbolic method of alternating-current calculation is very clearly described and illustrated.

Chapter XVII—which is continued in Chapter XXI—discusses constant-pressure and constant-current transformation. Taken together, the two chapters deal fairly thoroughly with the subject.

The three intervening chapters are quite short, and treat of capacity reactance, parallel circuits, distorted waves, and resonance effects. The theory and use of the wattmeter next receive attention, but, possibly, in too brief a fashion. Two excellent chapters follow on problems in electrostatics and on distributed inductance and capacity. The treatment is thorough, and necessarily of an advanced character.

Throughout the book, as the reviewer has tried to show, the authors have not scrupled to use mathematical analysis of all kinds where necessary, and yet we find in Chapter XXV a few notes on the mathematics of complex quantities. The reviewer is of the opinion that if this is the student's first introduction to this powerful method of calculation, it will not be of much use.

Transformers, hysteresis and eddy-current losses, and wave distortion in transformers are then dealt with in a satisfactory manner. Chapter XXX is devoted to mechanical stresses in transformers. The treatment is fairly good, but should have been illustrated by a few numerical examples to be really effective. We next find 16 pages discussing the general principles of transformer design. So far as it goes the chapter is fairly satisfactory, but surely it is out of place in a first-year course of electrical engineering, as is also the following chapter on polyphase transformer systems.

Chapter XXXIII deals in quite an elementary way with alternators. It should preferably have been placed much earlier in the book, or omitted altogether. Alternator armature reaction and the characteristics of alternators are next discussed with the aid of complex quantities.

A distinctly useful chapter on the leakage reactance of an alternator follows—useful, that is to say, to an advanced student, but not to a beginner.

The familiar, and often very troublesome, phenomenon of hunting in synchronous machinery is dealt with in Chapter XXXVIII. As the subject goes, the treatment is elementary, though one would not have been surprised to see cumulative oscillations necessitating the use of elliptic functions dealt with. Each chapter in this book is more or less of a surprise.

Chapter XXXIX deals with the design of constants of an alternator. A 100-KW. engine-driven alternator is taken as an

example. The method of design is not at all modern or good. Short-circuit currents in alternators are then discussed. The treatment is good and rigorous. This chapter is perhaps one of the most useful in the book.

Chapter XLI develops the equations of the synchronous motor, and these are well and clearly discussed by means of tabulated calculations and curves; while Chapter XLII deals with induction motors in a similar way.

The design of induction motors is next outlined. The reviewer does not consider the authors' method at all satisfactory. Indeed, in a footnote the authors point out that the work is not a book on electrical design. Their method is exemplified by the design of a 10-H.P. motor.

Rotary converters are then dealt with. The usual stereotyped equations are developed, and a clear account is given of the question of voltage control. The concluding chapter of the book deals in rather a neat and concise way with single-phase commutator motors.

From the above it will be seen that the book is scarcely suitable for the average first-year student. It is more a mine of wealth for the lecturer to third-year men.

The book is well printed, but bound in a cover which is very easily marked or stained.

From a number of the authors' footnotes, it is evidently intended to issue a companion volume giving an advanced course. Considering the character of the present "first course" work, the reviewer is filled with interest to know the style and contents of the "advanced course."—H. G. S.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The Remy Thermostatic Control.

A problem that has existed since electric generators began to be installed for lighting and engine-starting purposes on petrol motor vehicles, has recently been attacked by the Remy Electric Co., of Detroit, U.S.A., the outcome of the experiment being a thermostatic device for automatically increasing the current output of the dynamo in winter, when the demand for current is heavy, and decreasing it in summer when the consumption is more moderate. Temperature, which is chief among the causes of fluctuation in current consumption, is the agent relied upon for the operation of the new control, which is illustrated diagrammatically in the accompanying illustration.

Briefly stated, the idea is to use an automatic thermostatic switch in circuit with the field coils of the generator. Under normal conditions the switch is closed and the fields are at full strength. When, however, the temperature rises to a predetermined point, the thermostat opens and introduces a resistance into the field circuit; thus the field is weakened and the current output reduced. The reduction depends on the amount of resistance, and this, together with the temperature at which the device operates, is permanently adjusted at the factory before the generator is sent out.

The active element of the thermostat is a blade made up of a strip of nickel steel and one of spring brass, the two being welded together. One end of the blade is riveted to a stamped steel bracket and the other end, which is free, is fitted with a silver

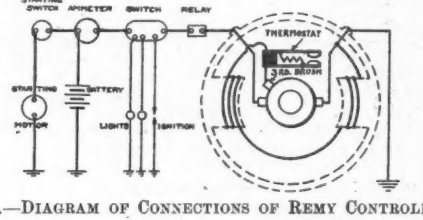

FIG. 1.—DIAGRAM OF CONNECTIONS OF REMY CONTROLLER.

contact button. A similar contact button is carried by the end of the bracket, and is adjustable by means of a small nut. The composite blade is insulated from its bracket by means of an insulating bushing where the rivets pass through. The resistance consists of a short length of wire insulated by a layer of mica. The connections are shown in fig. 1.

The thermostat is so set that at normal temperatures the silver contacts are pressed together firmly, and the field current is at full strength. When the temperature rises to 150° F., the contact points are separated and the field is weakened.

The thermostatic switch is located close to the commutator where the temperature is highest and where changes of temperature are first apparent. When the temperature of the atmosphere is high, as in summer, the generator naturally heats up more rapidly than in winter. Starting out with full field strength, the dynamo delivers its full output of about 21 amperes to the battery, and continues to do so for about the length of time required to put back into the battery the amount of current taken out during the operation of starting the car engine. After that, the resistance being put in circuit, the output falls to 14 or 15 amperes, and the battery gets the remainder of its charge at a low rate. When the temperature is low, as in winter, the generator heats up more slowly, and the full current is delivered to the battery for a longer time, giving the extra charging required to compensate for cold-weather engine-starting and for the extra car illumination required in winter-time.

Device for Giving an Image of the Searchlight Arc in Full Size.

In a short article in the *Journal of the U.S. Artillery*, by Capt. Adelno Gibson, Coast Artillery Corps, particulars are given of the above device, the essential parts of which are: (1) a pin hole through the side of the searchlight drum, opposite the arc; (2) a small mirror (about 2 in. × 2 in.) held in position on the side of the drum near the pin hole so as to catch the image and reflect it downward; (3) a holder attached to the tie rod, on which a piece of sectional paper is placed to catch the reflected image. Fig. 2 is a drawing of the apparatus, giving in detail all its essential features. The image projected on the sectional paper is an excellent reproduction of the actual arc, and shows how the arc is burning without necessitating looking at it through the coloured glass window in the searchlight drum.

On the most recently improved searchlights, as the Beck light and the Sperry light, lenses are inserted in the drum so as to give

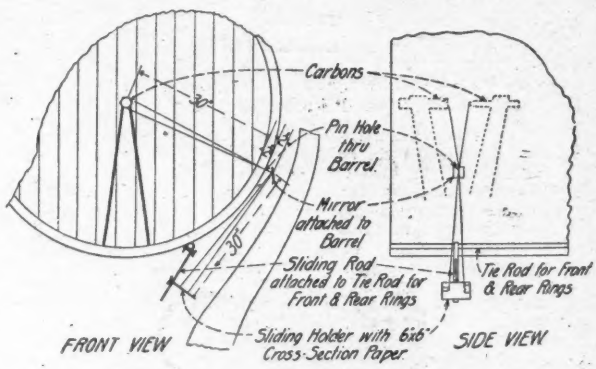

FIG. 2.—DEVICE FOR OBTAINING IMAGE OF SEARCHLIGHT ARC.

a reduced image of the arc on a piece of ground glass. On the lights now installed in the U.S. service, there is no device for giving an image of the arc. The purpose of this apparatus is to provide a cheap, easily made and efficient means for projecting a full sized image of the searchlight arc outside the drum and in such a position that the operator can readily observe the condition of the carbons, the length of the arc, and whether the arc is in focus. By making two marks on the sectional paper, showing the normal length of the arc and the correct position of the carbons when properly focused, the maintaining of a proper length of arc and keeping the light focused become very easy even to an unskilled operator.

The special merit of the device is that it provides a clear, full-sized image of the arc without the use of lenses, and yet in spite of a 32-in. focus, keeps the image in a convenient position near the searchlight drum.

The device as shown has been installed on one of the 60-in. searchlights at Fort Monroe, and has been found so satisfactory that the Coast Defence Artillery Engineer desires to have each light of the U.S. Coast Defence equipped with a similar apparatus. The materials for constructing the apparatus may be found among the scrap material at any post. The quality or shape of the mirror is of no consequence—any scrap of broken mirror will answer. The rod for holding the mirror passes through a small hole in the drum and is clamped in position by tightening two nuts, one inside and one outside the drum. The sheet metal holder of the sectional paper may be bent so as to enable the operator to see the image from any particular position desired. If so desired, the image on the sectional paper may be made clearer by surrounding the paper with a hood of sheet metal or of dark paper or cloth. This tends to exclude all light except that forming the image of the arc.

The small expense and ease of construction of the apparatus make it practicable, if so desired, to install the device on both sides of the searchlight.

Condensite-Cellulac.

A new form of electrical insulation is being placed on the market by the DIAMOND STATE FIBRE CO., of Bridgeport, Pennsylvania, called "Condensite-Cellulac." This material, it is stated, is entirely different in physical and chemical characteristics from any other form of fibre, hard rubber, mica, or synthetic insulation now available; it is homogeneous throughout, and combines the properties of "Condensite," which is employed in its manufacture, with the good qualities of the best grade of vulcanised fibre.

Condensite-cellulac is permanently anhydrous and non-hygroscopic, and is impervious to the action of oil or ordinary acids or solvents. It is infusible, and is not affected by the action of heat within the range of temperature ordinarily encountered; it is very tough, and will stand considerable vibration or shock.

It may be used advantageously in apparatus which is to operate under unfavourable conditions of moisture, or subject to splashing with oil, or where exhaust steam is used in industrial processes.

Condensite-Cellulac is furnished to the trade in sheets, rods, tubes, &c., and is readily machined. It may be formed into very sheets (·015 in. or less) with remarkable accuracy to gauge, thereby furnishing an excellent diaphragm material. It is also supplied shaped to customers' specifications. The work, as thus supplied, is ready for use, having been hardened and made insoluble and infusible by the application of heat. It can also be supplied in the soft uncured state, permitting of its being hardened in the place where it is to be used, and thereby formed to fit in spaces or locations with an accuracy not otherwise possible. Thus, for instance, gaskets for hot lines, steam, hot water, compressed air, &c., may be accurately fitted to rough flanges, and cured in place by the heat of the line.

Heater for Motor-Cars.

MESSRS. DRAKE & GORHAM, LTD., of 66, Victoria Street, S.W., have brought to our notice a neat heater for preventing motor-car radiators from freezing, or for taking off the chill from cold cylinders when starting up. It consists, as shown in fig. 3, of a perforated metal cylinder with nickel-plated ends, containing a heating element of wire wound on a strip of mica, which is attached to

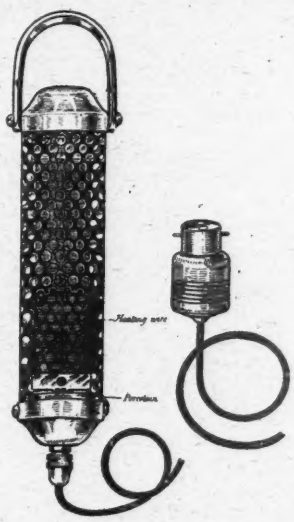

FIG. 3.—MOTOR-CAR HEATER.

porcelain plates; a flexible cord about 12 ft. long with a plug enables the heater to be connected to an ordinary lampholder, and a metal loop provides for hanging it on any convenient projection on the engine. The resistance is suitable for usual lamp-circuit voltages, and the wire never glows red, so that there is no fear of ignition of petrol vapour. It is a handy and useful device, and may find other applications besides that outlined above.

The "Kingsway" Signalling System.

Taking account of the new conditions to be complied with in signalling in mines, the GENERAL ELECTRIC CO., LTD., of London, has developed a new line of apparatus for this purpose, under the above title, which, while making full use of the advantages of electricity, provides such safeguards that no danger of explosion is to

FIG. 4.—INTERIOR OF THE DAVIES-RAILING RELAY.

be feared; the safety of the apparatus has been confirmed by exhaustive tests, and it complies with all requirements of colliery work and with the Home Office regulations.

For signalling along haulage roads the bare-wire system has been retained, but instead of a bell directly connected to the wires, the Davies-Railing patent relay is employed, which makes and breaks the local bell circuit in an explosion-proof box. Current for the line is derived from a three-volt battery, and a patent shielding winding is placed round the relay coils to damp out the inductive rise of voltage, so that danger from sparking on the wires is absolutely obviated. The relay closes the bell circuit in a mercury cup; fig. 4 shows the interior of the cast-iron box containing the relay, the box cover having long machined joints. No change is made in the method of signalling, the only difference being the insertion of the relay at a point near the bell. The relay is extremely sensitive, and operates with a current of "telephonic" strength.

This, however, is only one item in the "Kingsway" system, which includes also electrical shaft-signalling apparatus comprising indicators for the engine room, a bell for the banksman, a bell for the onsetter, and the necessary pushes, batteries, and wires. The engine-room indications are both audible and visible, and the mechanism is so contrived that the indicating finger remains standing at the last signal until a fresh signal is given, when the finger immediately flies back to zero and registers step by step the number of rings. Mining telephones and flame-proof bells, relays, and tappers also form part of the apparatus made by the company.

THE ELECTRICAL PRECIPITATION OF SMOKE AND FUMES.

FROM a paper read before the CANADIAN MINING INSTITUTE by Mr. WALTER A. SCHMIDT, we learn that the latest Cottrell plant is that which has been installed at the copper and lead smelting works of the Consol Mining & Smelting Co., at Trail, in the Rossland district of British Columbia. The apparatus is known as a "multiple-pipe treater," which distinguishes it from the earlier "plate-treater" system installed in other plants, which has now been practically superseded by the multiple-pipe form. The treater consists of a number of 12½-in. pipes, up each of which a central wire runs. This wire varies in size according to the conductivity of the gases, but in all cases its surface area is relatively very small as compared with the dust-collecting surface of the iron pipe. The wire may be made of any conducting material, but is commonly made of nichrome. The wire forms the discharging electrode, and the inner wall of the iron pipe is the collecting electrode. The wire is charged with electric current taken from a synchronous contact-maker, which produces an intermittent direct current at 60,000 volts from an alternating current supplied to the machine. There is, of course, a high difference of potential between the wire and the periphery of the iron pipe, with a resulting glow discharge between these at all points. The smoke—that is, furnace and roaster gases charged with suspended particles of matter and fume—is passed through these iron pipes upwards in a constant stream. Each little particle of suspended matter, somewhere in the course of its passage through a pipe, is struck by one or more ions, and becomes charged with static electricity. As the electrical sign of these charges is the same as that on the iron wire, and opposed to that of the pipe, the particles become attracted to, and settle on, the iron pipe.

The gases which the Cottrell dust-collecting plant treats at the works at Trail are drawn off from the furnaces and roasters in flues which lead them to the treaters. After passing through the latter, and being relieved of their burden of dust and fume, the gases continue in flues to the main chimney. The treaters are thus part of the flue system; they are built of steel throughout, set in concrete in the flues, and are erected in sections, each containing 32 pipes. The dust collecting on the pipes is shaken down and into a hopper at the bottom by an operator coming round and tapping the pipes with a hammer at certain stated intervals. In some cases, however, automatic tapping devices are fitted to the pipes.

The first installation at Trail consisted of 384 pipes, 15 ft. in length, in 12 sections; this treated the gases from three lead stacks, and was somewhat overloaded. Approximately 100,000 cu. ft. of gas was treated daily; during the course of last year, however, the installation was doubled in size, and a second plant has also now been installed; this consists of nine sections, and is intended to deal with the gases from the various lead-roasting furnaces. As a result of the success achieved, a third plant, consisting of eight sections, is being installed to treat the gases from the copper-converters. An interesting use of the plant is to be made in connection with the latter; in the lead-stacks a lead matte is made, which, after roasting, is returned to the furnaces. In time the lead matte becomes charged with so much copper that it is more valuable for the copper than the lead. Until now the practice has been to take this copper-lead matte and charge it into the copper furnace; in this way the copper is obtained as copper matte, but the lead is lost in the slag; the gold and silver contents are, of course, saved. It is now intended that the copper-lead-matte shall be blown in the copper converters along with copper-matte from the copper furnaces. The copper will all be obtained as blister-copper, and the lead will be blown off as lead oxide and lead fume, and precipitated in the No. 3 Cottrell plant.

The dust collected in the plant which treats the gases from the lead-stack is mainly sulphide of lead, containing from 65 to 70 per cent. lead. The dust collected from the roaster plant gases contains from 50 to 60 per cent. lead, and consists, roughly, of 60 per cent. lead sulphate, 20 per cent. lead oxide, and 20 per cent. lead sulphide. Lead losses in the stack have always been very high at the works at Trail, as but little provision for settling the dust by long flues or bag-houses had been made. Since, however, the Cottrell electrical process was adopted these losses have been reduced to a minimum. The erection of a fourth plant to treat the roaster gases from the new zinc plant is also under consideration, and, while little labour is necessary to keep them running, it is estimated that the power required to run all four plants will not exceed 200 H.P. Further experimental work in the direction of treating the gases from the lead-refining furnaces with the view of saving antimony and arsenic is also in progress.

THE RÖNTGEN SOCIETY.

AT the meeting of the Röntgen Society on January 2nd a paper was read by Mr. C. A. SCHUNCK, F.C.S., containing an account of his spectroscopic investigations into some sources of ultra-violet radiation. The researches, which were undertaken with a quartz spectrograph, had for their purpose the discovery of the relative efficiencies of various sources from the point of view of treatment by the ultra-violet rays. Mr. Schunck found that the tungsten arc was the most intense and efficient source of radiation at present available for this purpose.

Major W. J. TURRELL, with whom Mr. Schunck has collaborated, stated that the great practical difficulty at the present time was in getting a supply of tungsten at a figure not absolutely prohibitive. There was a very large quantity of tungsten available, enough to supply all the needs of the medical profession, but, although for military purposes the metallic tungsten was purchasable for 6s. or 6s. 3d. a lb., this supply was not available for general use, and all he could get for the civil hospitals was a pure tungsten costing about £4 4s. a lb. He made representations on the subject to the Ministry of Munitions, but no concession was granted. He suggested that the medical societies should move in the matter, as until the supply of tungsten was assured one could not expect instrument makers to go to the trouble of designing and manufacturing lamps for the supply of ultra-violet radiation. He thought that two kinds of lamps were required for therapeutic purposes, one the ordinary arc lamp, unenclosed, used with a director or condenser, and taking 10 or 12 amperes, and the other an enclosed lamp with a small opening in which one could fit a condenser or not as required, and taking 4 or 5 amperes. The latter type, he believed, would come to have a great value in the wards of the ordinary hospital and for the treatment of superficial wounds.

Major ROBERT WILSON, of the Canadian Medical Service, who exhibited last year a lamp consisting of a positive of tungsten and a negative of cored carbon, pointed out the value of ultra-violet radiation, more particularly in suppurating wounds, and said that a lamp of the type he had designed did not cost more than £10 to make, took about 4½ amperes, and furnished all the ultra-violet rays required. He did not think there was anything to be gained by saturating the carbons instead of coring them.

Mr. J. H. GARDINER suggested that there was no need to be discouraged about the difficulty in getting a supply of tungsten, for iron went a long way, and impregnation with uranium, too, would give a valuable concentration of intensity.

Mr. SCHUNCK, in replying on the discussion, said that spectroscopically one got as good an effect with one tungsten and one carbon as with two tungsten electrodes. He thought that the spark spectra might be used for treating very small areas with a condensing lens. The best source of light for this purpose was carbons impregnated with uranium nitrate and ammonium molybdate.

Car Lighting and Engine Starting for Motor-Cars.—From an interesting article in the *Horseless Age*, of New York, on the subject of the tendencies of design in petrol motor-car construction, we learn that the tendency of the times as regards the car-lighting and engine-starting equipment is to make the dynamo of the former and the electric motor of the latter as separate units, this plan having been adopted on 84 per cent. of the 1917 models of cars which have, so far, been announced, as against 61·7 per cent. a year ago. The voltage now in favour is 6 volts, this being adopted on 89·5 per cent. of the cars, leaving only 10·5 per cent. fitted with 12-volt sets. As regards the wiring, the single-wire system with earthed return has slightly increased in popularity amongst motor engineers—from 82 to 83 per cent.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

18,462, 18,463. "Sparking plugs for internal-combustion engines." C. F. L. KING. December 27th.

18,464. "Electrodes of sparking plugs for internal-combustion engines." C. F. L. KING. December 27th.

18,466. "Electric starters for internal-combustion engines." C. F. L. KING. December 27th.

18,503. "Electric signalling lamps." H. LUCAS & C. L. BREEDEN. December 27th.

18,504. "Electric starters for internal-combustion engines." A. H. MIDGLEY AND C. A. VANDERVELL & Co. December 27th.

18,506, 18,507. "Electric incandescent arc devices." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). December 27th.

18,509. "Electrical transformers." A. G. ELLIS & J. L. THOMPSON. December 27th.

18,510. "Insulators for leading-in electrical conductors." J. C. H. VAN DUYL. December 27th.

18,511. "Dynamo-electric machines." E. W. DOREY. December 27th.

18,541. "Electrical apparatus for permanently waving natural hair on the head." E. F. SUTEN. December 28th.

18,552. "Apparatus for advancing the spark in internal-combustion motors. SOC. ANON. POUR L'ECLAIRAGE ELECTRIQUES DES VEHICULES. December 28th. (France, September 9th.)

18,553. "Electrolytic production of non-metallic substances." G. F. JAUBERT. December 28th. (France, December 29th, 1915.)

18,584. "Electric hand-lamps, &c." J. F. BUCKINGHAM. December 29th.

18,591. "Absorber adjustment for X-ray machine to absorb nitrous and nitric compounds generated from the air by electric discharge." H. SOMERFIELD. December 29th.

18,609. "Electric warming apparatus." H. T. PINNOCK. December 29th.

18,611. "Accumulators, and particularly electrodes or plates for accumulators and electrochemical apparatus." I. CHKLIAR. December 29th. (France. December 29th, 1915.)

18,624. "Trolley heads for electric tramcars, &c." J. N. WAITE. December 29th.

18,649. "Electro-mechanical make-and-break movement." F. DE CANNART D'HAMALE. December 30th.

18,658. "Dies for pressing or moulding porcelain or earthenware articles." P. COOPER. December 30th.

18,661. "Control gear for controlling alternating-current motors." R. J. GOITERSON & J. A. STEVEN. December 30th.

18,672. "Apparatus for transforming, and especially for rectifying, alternating or polyphase currents." J. F. G. P. HARTMANN. December 30th. (U.S.A., December 30th, 1915.)

PUBLISHED SPECIFICATIONS.

1915.

14,423. TRANSFORMERS FOR INCREASING THE FREQUENCY OF ALTERNATING ELECTRIC CURRENTS. Marconi's Wireless Telegraph Co. & I. Shoenberg. October 12th.

17,092. X-RAY PHOTOGRAPHY. T. T. Baker. December 4th.

17,191. MAGNETO ELECTRIC IGNITION DEVICES FOR INTERNAL-COMBUSTION ENGINES. O. Heins. December 7th. (January 22nd, 1915.)

17,321. TELEGRAPHIC AND LIKE RECEIVING DEVICES. A. J. Roberts. December 9th. (Cognate application, 5,090/16.)

17,325. THERMAL ELECTRICAL SWITCHING AND/OR ACTUATING APPARATUS FOR THE AUTOMATIC CONTROL OF TEMPERATURE. E. C. St. John. December 10th.

17,497. ELECTRIC AND PNEUMATIC CONTROL MECHANISM, PARTICULARLY FOR USE IN DENTAL SURGERY. O. H. Pieper & A. F. Pieper. December 14th. (October 15th, 1915.)

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

723. ELECTRICALLY-OPERATED PORTABLE VACUUM CLEANERS. H. Scholey. January 17th, 1916. [102,521].

948. ELECTRIC SWITCHES. F. J. Testor & F. Testor's Fabriks Aktiebolag. January 20th. 1916. [102,523.]

972. COIN-FREED TELEPHONIC APPARATUS. F. M. Balding, J. E. Scantlebury and G. S. P. Scantlebury. January 20th, 1916. [102,396.]

1,502. TESTING ARRANGEMENT FOR MACHINE TELEPHONE SWITCHING SYSTEMS. Western Electric Co. (Western Electric Co., U.S.A.). February 1st, 1916. [102,531.]

1,897. SPARKING PLUGS. J. L. Evans. February 9th, 1916. [102,402.]

2,044. WALL BOXES FOR CONTAINING ELECTRICAL SWITCHES, PLUGS, AND THE LIKE. A. E. Read, J. E. Franks & M. Brooks. February 11th, 1916. [102,404.]

3,599. CIRCUIT ARRANGEMENTS FOR TELEPHONE OR OTHER INSTALLATIONS PROVIDED WITH SELECTING DEVICES. Siemens Bros. & Co. and T. Pettigrew. March 10th, 1916. (Addition to 7,128/13.) [102,419.]

4,625. ELECTRIC TORCHES. A. A. King. March 29th, 1916. [102,426.]

5,596. INTER-COMMUNICATION TELEPHONE SYSTEMS. J. W. Dungey & C. B. Kersting. April 17th, 1916. [102,565.]

6,589. STARTING AND STOPPING DEVICES FOR ELECTRIC MOTORS. J. G. Henderson. May 8th, 1916. [102,434.]

7,252. ELECTRIC DEVICES FOR AUTOMATICALLY TURNING LIGHTS ON OR OFF. E. Steiger. May 22nd, 1916. [102,575.]

7,334. TELEGRAPH KEY. F. Palmer. May 29th, 1915. (Patent No. 100,590.)

7,616. ELECTRIC SIGNALLING APPARATUS. F. Ritchie. May 29th, 1916. [102,445.]

8,310. ELECTRIC METERS OR RELAYS. British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric and Manufacturing Co., U.S.A.). June 12th. (Patent No. 102,336.)

8,339. HOLDERS FOR ELECTRIC LAMPS. R. B. Benjamin. July 8th, 1915. [100,836.]

9,040. ALIGHTING SIGNAL APPARATUS FOR AEROPLANES AND HYDRO-AEROPLANES. August 21st, 1915. (Patent No. 101,283.)

9,179. TELEPHONE SYSTEMS. E. Merriman. June 29th, 1916. [102,454.]

9,249. MEANS FOR CONTROLLING ELECTRIC MOTORS. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). June 30th, 1916. [102,585.]

9,927. METHODS OF AND APPARATUS FOR PRODUCING ASYMMETRIC WAVES OF ELECTROMOTIVE FORCE. British Westinghouse Electric & Manufacturing Co. July 14th, 1915. [100,893.]

10,335. IONISATION DEVICES FOR AMPLIFYING ELECTRIC CURRENTS AND SIMILAR PURPOSES. Western Electric Co. (Western Electric Co., U.S.A.). July 22nd, 1916. [102,589.]

13,820. AUTOMATIC IGNITION ADVANCING DEVICES FOR MAGNETOS. L. Bignon and J. C. Rousset. October 2nd, 1915. (Patent No. 101,712.)